



THE FN MAG MACHINE GUN

M240, L7, and other variants

CHRIS McNAB





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CONTENTS

INTRODUCTION

DEVELOPMENT

Designing the optimal front-line weapon

USE

Reliability under fire

IMPACT

Surviving changing times

CONCLUSION

BIBLIOGRAPHY



INTRODUCTION

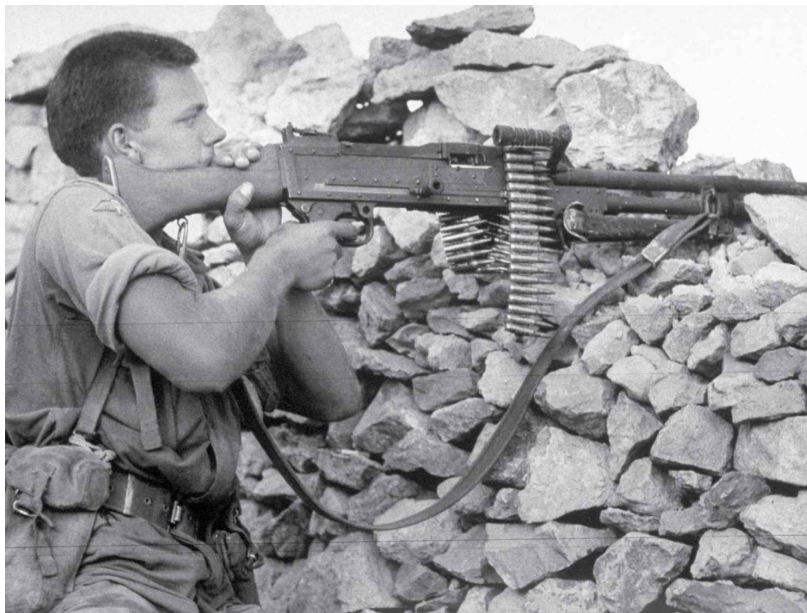
Firearms can, to those who have little contact with them, appear as a rather undifferentiated mass. For those who use them either for sport, self-defense or military combat, however, firearms are far more stratified and nuanced. For them, small arms are a true “family,” and like any family there is characterful diversity.

Looking at the broadest typology of firearms, we can divide them into the following types: handguns (pistols and revolvers), submachine guns, rifles (bolt-action and self-loading), shotguns, and, at the heavy end of the spectrum, machine guns. Each of these types offers a spectrum of strengths and weaknesses. Handguns, for example, provide the ultimate in portability, being capable of sitting conveniently and discreetly in a holster, ready for deployment in seconds. On the downside, most handguns lack both power and range, being largely useless at engaging targets at much more than 50m (55yd) away. An assault rifle, by contrast, offers plenty of power and penetration within roughly a 600m (656yd) range, plus the tactical flexibility of selective fire (full-auto or semi-auto), a magazine capacity of around 30 rounds, and dependable accuracy, especially when fitted with a modern optical sight. On the flip side, even the assault-rifle bullet will run out of steam quickly beyond 600m – accuracy farther than that is typically the province of the sniping rifle or battle rifle. It also has a fixed barrel and a magazine feed, meaning that if you keep your finger down on the trigger in full-auto mode, you’ll be changing magazines every few seconds, as well as building up to a potential barrel or operating-system failure.

So, if you want power, range, and sustained full-auto destruction, you arrive at the machine gun, sitting at the top of the small-arms family tree. By definition, machine guns are belt- or magazine-fed weapons capable of sustained fire using rifle-caliber or larger cartridges. As we shall see in this book, machine guns themselves can be placed into one of several internal categories or can, as in the case of the FN MAG – the subject of this book – attempt to straddle several at the same time. Yet before launching into our analysis of the origins, evolution, and use of the FN MAG, it is worth clarifying in general what machine guns are actually *for*.

First, and perhaps most obvious, machine guns serve to inflict attrition and destruction on both personnel and materiel, in a more concentrated and rapid

fashion than individual rifles. Why are they so good at doing this? First, the machine gun has a full-auto capability, typically in the region of 500–1,200rd/min cyclical rate, meaning that it can put lots of rounds on target very quickly, creating a “beaten zone” of hideous lethality. Yet rapid fire alone is not what gives a machine gun its true power – after all, many submachine guns can shoot as rapidly as a full-blown machine gun, but with a fraction of the impact at distant ranges. The machine gun takes its full-auto power and combines it with four factors: (1) an extensive ammunition supply, typically in the form of belt feed, which means it can maintain longer bursts over longer durations; (2) a full-power rifle cartridge, resulting in extended ranges and the increased penetrative effect of multiple rounds striking a target in rapid succession; (3) mounting systems (bipods, tripods, antiaircraft (AA) mounts, etc.) that allow greater controllability of the rapid fire, including in an indirect-fire mode; (4) a heavier barrel, and/or changeable barrel, plus a generally robust construction, to enable it to cope with the slamming physical demands of firing powerful cartridges in rapid and prolonged fashion. Take these factors together, and you have a gun that can wipe out dozens of men in seconds, and destroy vehicles, positions, and equipment with relentless erosion.



By the mid-1960s the FN MAG was in service with British forces around the globe as the “General Purpose Machine Gun” (GPMG). This soldier is using his GPMG in the “Light Role” (bipod-mounted for section support), with just a 50-round belt. (Photo by Terence Spencer/The LIFE Images Collection/Getty Images)

Yet beyond brute destruction, the machine-gun also has a critical tactical role in *suppression*. As much as machine-gun fire is intended to wipe out what it is fired at, it also serves to keep the enemy cowering behind a wall or hunkering down in a trench. By suppressing the enemy's freedom of movement, the machine-gun team thereby gives other friendly soldiers the ability to maneuver themselves into advantageous positions. Fire discipline is naturally required here – if a machine-gunner wanders beyond his agreed sectors of fire, he can be just as likely to shoot up his own men as his opponents. But if controlled effectively, machine-gun fire can almost be as effective as artillery in keeping the enemy heads down.



A US sailor serving with the Coastal Riverine Squadron lets fly with an M240B during a training exercise. The gun appears to be fitted with a blank-firing attachment, hence the vertical alignment of the muzzle flash. (MC2 Joshua Scott/Wikimedia/Public Domain)

So, it might be concluded that designing a machine gun is a straightforward affair, the best machine gun being that which can deliver the attrition and suppression roles with the most dependable reliability. Unfortunately for firearms designers, this is far from the case. Machine-gun design is also constrained by a series of other factors, and the way the designer approaches these considerations fundamentally changes the nature of the gun. Crudely put, the more robust the machine gun, and the beefier and more solid the mount, the better it is at reliably delivering intense and prolonged fire. Yet large weapons are physically very heavy and large, as is the ammunition that goes with the weapon. Thus they are not easy to move around the battlefield, and therefore require a team of soldiers to operate, in much the same way as an artillery gun

battery. In response, a machine gun can be made lighter, doing away with sophistications such as a changeable barrel and a hefty tripod, and the caliber of the weapon can be reduced to make ammunition less of a physical burden. Now the gun becomes lighter and more portable, capable of being moved freely around the battlefield by a single individual. At the same time, however, its ability to deliver sustained fire decreases, weakening both the attrition and suppression elements of the machine-gun equation. In short, the heavier the machine gun, the less mobile but more destructive it is; the lighter the machine gun, the more portable but less destructive it is.

Machine-gun design is therefore about having to make the right choices between tactical purpose and firepower. To achieve an appropriate balance, many armies have, as we shall see, sought to have a mixture of machine-gun types on the front line, ticking all the check boxes through variety rather than compromise. Others have sought to develop machine guns that are capable of fulfilling multiple machine-gun roles within the same weapon, just by altering its mount configuration.

Here enters the FN MAG. The story of the FN MAG is essentially that of a weapon trying and largely succeeding in finding the optimal blend between mobility and firepower. Although the FN MAG was not the first “general-purpose machine gun” (GPMG) to enter service, it is arguably the single best representation of the type in the post-1945 world. To date, the FN MAG has equipped the armies of more than 80 nations, and has served reliably in every conceivable type of terrain, from Arctic tundra to Middle Eastern deserts and South American tropical jungles. Through numerous updates, variants, and optional fittings, the FN MAG has kept pace with tactical and technological developments. At the same time, it has never moved away from the fundamental simplicity and reliability that has made it a truly battle-winning weapon.



An Israel Defense Forces (IDF) gunner's assistant makes adjustments to the MAG's tripod settings while spotting for targets during a drill in the Golan Heights, northern Israel, in 2012. (Staff Sgt (res.) Abir Sultan/IDF/Wikimedia/**CC BY-SA 3.0**)



DEVELOPMENT

Designing the optimal front-line weapon

THE ORIGINS OF THE GPMG

The FN MAG can only be understood properly if placed into its historical and tactical context. To do that it is useful to conduct a whistle-stop tour of machine-gun evolution from the late 19th century until the end of World War II. The world's first self-loading machine gun (as opposed to hand-cranked, manual-loading weapons such as the Gatling Gun) was developed by Hiram Maxim, with patents issued in 1883. The recoil-operated Maxim Gun could fire rifle rounds from a 250-round canvas belt at 600rd/min; Maxim delighted in demonstrating this capability for the rich and powerful through environmentally careless feats such as chopping down large trees with bullets alone. The Maxim was instantly appreciated and progressively adopted by the world's armies, who produced their own variations, such as the German MG 08, the British Vickers, and the Russian PM 1910. It was machine guns such as these ultra-reliable monsters that cut down generations of young men across the battlefronts of World War I.

The Maxim-type guns, especially when combined with their mounts, were acutely heavy, however, and suited only to emplaced sustained-fire support roles. Some designers therefore recognized the advantages of having a lighter type of machine gun, one that could be carried forward in the assault by a single individual. This impetus gave birth to the concept of the "light machine gun" (LMG), as opposed to the "heavy machine gun" (HMG) such as the Vickers and Maxim. Often with lighter, fixed barrels, magazine feed instead of belt feed, and air-cooled instead of water-cooled (the latter required a very heavy coolant-filled barrel jacket), early LMGs often utilized a gas-actuated mechanism, which was lighter than the heavy parts required in a recoil-operated weapon. Examples of these early LMGs include the Hotchkiss M1909, the Lewis Gun, and the Browning Automatic Rifle (BAR), plus ill-conceived wartime efforts to create an LMG out of one of the heavier weapons, the German MG 08/15 being a prime example.

So, World War I came to an end with the machine-gun armory roughly divided between LMGs and, at the opposite end of the scale, HMGs. There was soon to be another gradation, however, when the concept of the medium machine gun (MMG) was formulated. The definitions of LMG, MMG, and HMG are, it must be acknowledged, a little blurry, and can shift a little according to who is describing them and according to the slice of history within which they are defined. As a general rule, however, the MMG is classified as a belt-fed, air-cooled machine gun of standard infantry-rifle caliber. One of the finest early examples of the MMG is the Browning M1917, a .30-06 water-cooled machine gun that saw limited service in the last days of World War I, but heavy service in the following world war, especially in its M1919 air-cooled variant. In the HMG category are the water-cooled sustained-fire weapons of the early period, plus the heavy-caliber and physically large monsters such as the .50-caliber Browning M2, developed toward the end of World War I and still in use today as the venerable M2HB. Conversely, the LMGs, with their magazine feed and light, fixed barrels, were one-man affairs, good for beefing up squad firepower but poor for raining down a sustained stream of destructive bullets.



The M1918 Browning Automatic Rifle (BAR) provided the inspiration for the MAG's gas-operated system. Unlike the MAG, the BAR had an upward-rising bolt-locking piece; the MAG locking lever was cammed downwards. (© Royal Armouries PR.5303)

By the beginning of World War II, most major combat armies had machine guns across the three types, creating a balanced portfolio of firepower from squad to company and battalion levels. The Americans, for example, had the BAR at the light end, the Browning M1919, and the Browning M2HB in the HMG capacity. During the 1930s, however, a new innovation had occurred, courtesy of the Germans. Developed from the late 1920s, and introduced in 1934, the MG 34 was an *Einheitsmaschinengewehr*, or general-purpose machine gun (GPMG). It was a 7.92×57mm belt-fed, air-cooled weapon, but with a quick-change barrel that with some dexterity on the part of the machine-gun team allowed sustained fire to be laid down. What made it cross into the “general-purpose” category was that it could shift roles depending on the mount

and ammunition feed. On its integral bipod and fitted with the 75-round drum magazine, it was an LMG. Put it on a heavy tripod system, and switch to the belt feed, it was an MMG. Place it on vehicular or AA mounts, and it was straying toward the HMG category. It was, in essence, a universal machine gun.



The FN MAG has been an integral part of the IDF arsenal for more than 40 years. Here a MAG (bottom) sits alongside an IDF Mk 19 grenade launcher and .50-caliber M2HB machine gun.

(Ido403/Wikimedia/**CC BY-SA 3.0**)

The MG 34 effectively introduced and proved the GPMG concept (it had some less famous predecessors), but it was the cheaper, faster-firing MG 42 that displayed the GPMG potential in most fearsome style. Both weapons gave the German armed forces a firepower flexibility that inflicted cruel levels of casualties on the Allies, both in mobile offensive and static defensive roles. Hence when World War II ended in 1945, both the Europeans and the Americans began to consider the GPMG type for their armed services. It was at this point that Fabrique Nationale, and the FN MAG, entered the picture.



One of the inspirations for the FN MAG was the German MG 42, a 7.92mm recoil-operated weapon, and one of the first of the GPMG type. Its descendant, the MG3, remains in service with German and other forces. Here, soldiers of the Bundeswehr, the German armed forces, participate in live-fire military exercises on September 25, 2012 near Münster, Germany. (Photo by Ulrich Baumgarten via Getty Images)

TOWARD THE FN MAG

Fabrique Nationale d'Armes de Guerre (FN; "National Factory of Weapons of War"), later to become Fabrique Nationale d'Herstal (National Factory of Herstal), is one of the great names in the history of European firearms production. Founded in 1889 in the Belgian city of Herstal, near Liège, to satisfy the requirements of a government order for Mauser rifles, FN grew impressively during the first half of the 20th century, manufacturing both military and civilian sporting weapons. FN's commercial success was fueled by its efficient design and output of new weapon types, plus its canny alliances, particularly as the European arm of the American Browning Arms Company – John Moses Browning himself worked as one of FN's designers. FN also became a producer of Winchester firearms.

The German occupation of Belgium between 1940 and 1944 naturally brought disruption to FN's activities, but in the postwar period it resumed its work in earnest. It was quickly evident that the small-arms landscape of the 1950s would be very different to that of the war years. For military use, revolvers were out, and the focus concentrated on semi-auto handguns with high-capacity magazines. The world's armies were now looking to re-equip with new generations of semi-auto and full-auto assault rifles, dispensing with the bolt-action rifles of the past. Ammunition standardization was also taking place as the East vs West Cold War alliances embedded themselves, with the North Atlantic Treaty Organization (NATO) adopting the 7.62×51mm NATO cartridge as its standard rifle and machine-gun round in 1954. FN's place in these changing

times was assured by two weapons above all others. One was the FN FAL rifle, and the other was the FN MAG machine gun.

The key mind behind the FN MAG was FN designer Ernest Vervier, who led a team to look into the possibility of developing a new machine gun in the GPMG mold. This focus was doubtless a sound commercial choice on the part of FN. With the core weapon designed, FN only then needed to offer a selection of mounts to meet a multiplicity of buyers' needs. Furthermore, many foreign armies were crying out for improvements in their infantry firepower. The American services, for example, had an awkward firepower gap between the BAR LMG, which only had a magazine capacity of 20 rounds, and the .30-caliber Browning MMGs, which were not well-suited to sustained fire and also had a relatively low rate of fire, at around 600rd/min. The British had things even worse, with the excellent .303in Bren LMG requiring conversion to the new 7.62mm caliber (producing the L4 machine gun, which served until the 1990s) then little between that and the aging water-cooled Vickers.



During the combined US/Canadian NATO exercise *Rendezvous '83*, a Canadian soldier aims his heavy-barrel 7.62mm C2 battle rifle from a prone firing position while participating in a mock battle at Camp Wainwright, Alberta. The sustained firepower of the heavy-barrel FAL variants was limited by the fixed barrel and the magazine ammunition feed, hence the British forces focused their investment on the MAG. (Spec. 5 Vince E. Warne/Wikimedia/Public Domain)

For inspiration, and rather than reinvent the wheel, Vervier looked to two primary sources – the BAR and the MG 42. From the BAR, he essentially took the robustly reliable gas-piston mechanism and bolt group, proven for its smooth operation and reliability. The new machine gun, however, had to be capable of belt feed rather than magazine feed, hence the bolt mechanism was effectively inverted, with a locking lever engaging with a locking shoulder on the floor of

the receiver, rather than on the top of the receiver as with the BAR. By inverting the bolt, Vervier was also able to place a lug on the top of the breech block, the lug engaging with a cam track that in turn powered the belt-feed mechanism. Another BAR borrowing was the rotating barrel-change mechanism, actually from the FN Model D version of the BAR (the other versions had fixed barrels), while from the MG 42 came the tried-and-tested trigger mechanism and a spring-loaded dust cover over the ejection port. Feed was via metallic belt, with either disintegrating or non-disintegrating links, and the 7.62×51mm NATO cartridge was adopted to comply with the emerging NATO standardization.

The FN MAG was being formulated with a business-like attitude to proven past weapons, but Vervier also brought innovations. To ensure that the fast-firing gun was reassuringly reliable, it used a “hard” buffer recoil system, in which the recoil of the piston extension was transferred into a braking ring and a series of spring compression washers, rather than a heavy recoil spring assembly. Although the recoil therefore felt by the user was a little more bruising, the fast return velocity of the piston extension and bolt group meant that the gun had an extremely reliable use of its energy. Standard mount options were either the gun’s integral bipod, a tripod system, or various vehicle mounting options.



January 1978: this wounded British soldier is armed with an L4A1 light machine gun while on patrol in County Fermanagh, Northern Ireland. The gun is fitted with the slightly curved 30-round magazine, as opposed to the straight-sided 20-round magazine. (Photo by Alex Bowie/Getty Images)

In its basic specifications, the FN MAG was 49.21in long, with the barrel taking up 21.50in of this length. The gun had an empty weight of 22.38lb; add a belt of ammunition and it was clear that this was no weapon for those with lightweight physiques. It had a rate of fire of c.850rd/min, making it particularly

fast-firing when compared to many of the MMGs available at the time. Its muzzle velocity was 853m/sec (2,799ft/sec), and depending on the mount type and sights the gun had a range that could confidently tackle targets out past 2,000m (2,187yd).



April 1972: a British soldier trains his GPMG on an alley in Belfast, Northern Ireland, the weapon set on the L4A1 mounting tripod. Note the L1A1 rifle next to him. The L1A1 was the British adaptation of the FN FAL rifle, and the MAG/FAL pairing was a common adoption in global forces during the 1960s and 1970s. (Photo by Alex Bowie/Getty Images)

The new machine gun was labeled the *Mitrailleuse d'Appui Général* (MAG; General-Purpose Machine Gun), and it went into production in 1958, hence the gun is also known as the MAG 58. It emerged in three primary variants, the nature of these models reflecting FN's intention for the MAG to have a true general-purpose application. The core model was the **MAG 60.20**, or standard model, which remains the core MAG type even today. The 60.20 comes with a pistol grip, wooden or polymer stock (the polymer stock is a modern conversion option that makes weapon decontamination easier in Nuclear Biological Chemical/NBC environments), and an integral bipod fitted around the gas cylinder, just behind the gas port. For close-quarters use, particularly in the context of jungle warfare, FN also produced the **MAG 10.10**, which had a shorter barrel and buttstock, although this was an uncommon model. FN designed variants for vehicular and aircraft use from the outset. The **MAG 60.30** is a solenoid-fired variant primarily intended for mounting in helicopter gun pods or flexible door mounts. As one would expect, the 60.30 lacks the pistol grip, bipod, and stock, the latter sometimes replaced by spade grips. Finally,

there was the **MAG 60.40**, a coaxial version for installation in armored fighting vehicles (AFVs).

It is striking that that the FN MAG went through its trials and into production in the 1950s, more than 60 years ago. The gun still forms the cornerstone of support firepower in many armies, such are its qualities. Indeed, it was clear from the outset that the MAG was arguably superior to anything else that was available on the market.

A GLOBAL SUCCESS

The MAG had an immediate impact on both the indigenous and international weapon markets. Following its superb performance in trials, the Belgian Army adopted its homegrown machine gun in 1958, but it was just the first of many recipients. More than 200,000 units have been produced to date, and licensed producers alone include Argentina, Egypt, India, Indonesia, Singapore, Sweden, and the United Kingdom, each country either making the gun to the exact FN model specifications or building their own subtle requirements into the design. More than 80 other international customers have also bought the MAG in large volumes, for service ranging from standard infantry machine guns through to helicopter-mounted weapons and even naval firepower. It should also be noted that over the MAG's lifetime FN have continually invested in refinements to key components, such as the gas regulators, barrel design, and furniture.



These Belgian soldiers armed with the MAG M2 (left) – the FN MAG 60.20 – and Minimi M2 (right) machine guns are pictured at Leopoldsburg, Belgium, in May 2011. The Belgian forces are moving to replace the MAG with the Minimi Mk 3. (Photo by: Arterra/ UIG via Getty Images)

One of the earliest customers for the MAG was Sweden, which took the weapon from 1958 and began licensed production under the Carl Gustav brand. The gun was designated the **Ksp 58** (*Kulspruta* 58; “Machine-Gun 58”), but reflecting the fact that Sweden was outside the spread of NATO standardization it rebarreled the MAG to the Swedish Army’s own 6.5×55mm Mauser caliber. The Ksp 58 took its place alongside another Swedish Army machine-gun adaptation, the Ksp m/42, which was actually an M1919A6 derivative chambered for the 6.5mm cartridge or for the 8×63mm patron m/32. Yet the global march toward the 7.62mm NATO round was inexorable, and during the early 1970s the Swedes adopted the 7.62mm MAG as the **Ksp 58B**. The gun was also fitted with the new FN gas regulator type, the Type B, which permitted a more efficient and adjustable control of the gas flow through the gas port into the gas piston.

While the new Ksp 58B would serve the Swedish infantry, and still does today, the Ksp 58 would also be produced in variants for vehicle use, particularly for applications to the Stridsvagn 103 main battle tank (MBT). This variant, stripped of the standard model’s furniture, was known as the **Ksp 58 Strv**, and three of these weapons were fitted to each Stridsvagn 103 – two fixed and forward-firing guns in the hull, and another set in a remote mount on the roof to act as AA defense or another ground-attack weapon. Although the Stridsvagn 103 is no longer in service – it was phased out in the 1990s – the MAG is still used in Swedish vehicular format as the **Ksp 58C**, fitted from 2014 as the coaxial machine gun on the Stridsfordon 90 AFV.

From 2005, the Swedish Army received a radically updated version of the MAG in its inventory, the **Ksp 58D**. This weapon is a perfect illustration of how the MAG has kept itself continually relevant to the changing nature of machine-gun design and advances in material technology, while not disrupting the core design of the original MAG. The primary objective of the Ksp 58D design was to give the infantry a gun that was more portable, and better adapted to the fitting of additional accessories. Instead of the fixed wooden stock, the Ksp 58D has a collapsible or folding stock to improve the convenience of storage within AFVs; the stock is also of a skeleton design to reduce overall weight. Also for weight reduction, the barrel is fluted and reduced in length to 19.17in, a fact that drops the gun’s effective range down to around 1,500m (1,640yd) but takes the overall weight of the gun down by about 4.4lb. Note that the flash hider is also shortened, and at a mechanical level the Ksp 58D has a simplified gas regulator, with just four gas settings instead of the typical eight.

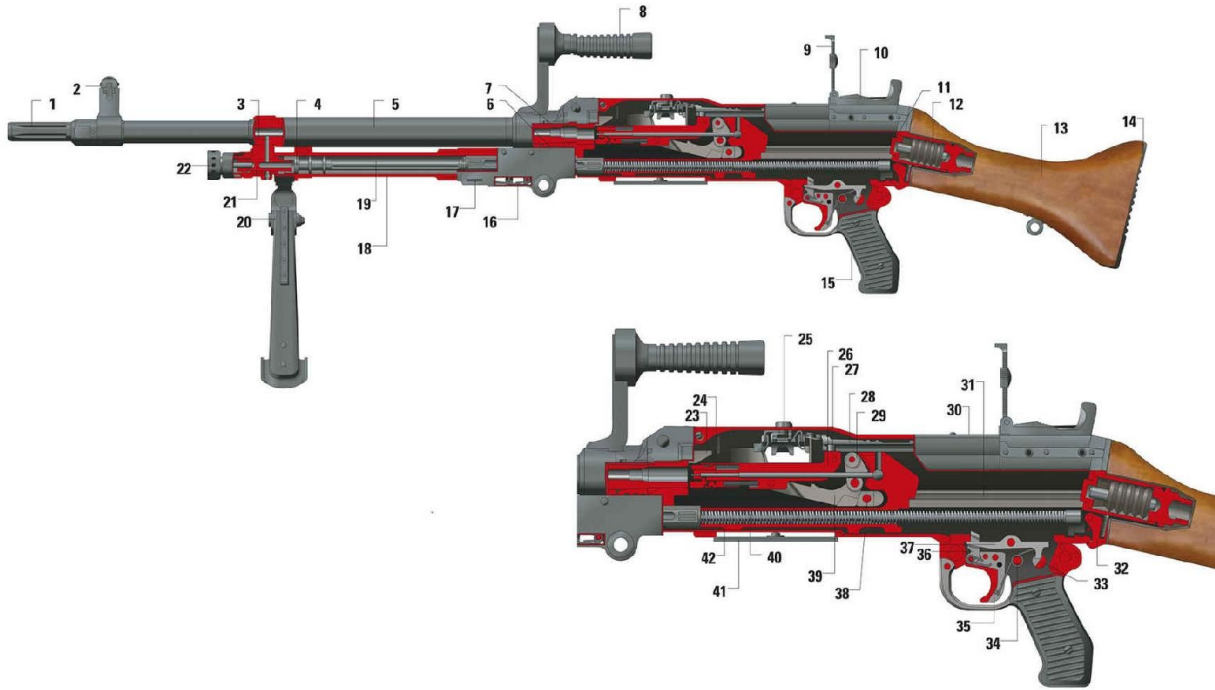
Other refinements in the Ksp 58D include the fitting of a MIL-STD-1913 rail (adjustable or fixed) on the top of the receiver to facilitate the use of various optical and night-vision sights. Fitting the rail has necessitated the shortening of the carrying handle to half its original length. The gun also has new ammunition-feed options, including a 100-round ammunition pouch that clips to the side of the gun, enabling one man to carry and use the gun in fluid maneuver actions, such as in urban warfare. The Ksp 58D reflects a general modern desire to improve the firepower of the infantry at a small-unit level, as some armies seek better support fire than can be provided by machine guns of lighter calibers, such as 5.56mm.



The MAG has been produced in numerous national variants. Here we see one of the first to be issued to a national army, the Ksp 58B of the Swedish Army. (Armémuseum (The Swedish Army Museum)/Wikimedia/**CC BY 4.0**)

THE FN MAG EXPOSED

7.62×51mm L7A1 GPMG



1. Flash hider
2. Front sight
3. Gas vent
4. Piston head
5. Barrel
6. Barrel nut
7. Chamber
8. Carrying handle
9. Rear sight
10. Rear sight ramp
11. Buffer plate
12. Buffer assembly
13. Buttstock
14. Butt plate

15. Pistol grip
16. Bipod catch
17. Slot for bipod leg
18. Gas cylinder
19. Gas piston
20. Bipod assembly
21. Gas plug
22. Gas regulator
23. Cartridge stop
24. Firing pin
25. Feed pawls assembly
26. Breech block
27. Actuating stud roller
28. Feed arm

29. Link
30. Top cover
31. Breech block guide
32. Butt catch
33. Safety catch
34. Sear and trigger spring
35. Trigger
36. Sear tripper
37. Sear
38. Locking shoulder
39. Locking lever
40. Return spring
41. Ejection opening cover
42. Piston

BRITISH MAGS

Alongside the Americans (with their M240 variant), the British have been the most enthusiastic adopters of the MAG weapons. During the 1950s, the British Army began looking around for weapons that would offer better LMG fire than the wartime Bren Gun then in service, and which could replace the aging Vickers in the MMG support role. Even though the Bren was modified to take the 7.62mm NATO caliber, its capabilities were still limited by the top-mounted box magazine. A belt-feed version of the Bren, the X11, was developed by the Enfield firearms company as a possible solution, and it went into tests against some of the other weapons that were emerging onto the market at the time. These included the American M60, French AA-52, Danish Madsen-Saetter, Swiss SIG MG 55-2 and 55-3, and also the FN MAG. Through a series of competitive trials, the British steadily rejected not only the new indigenous Bren – the design was simply too complex and reliability was poor – but all of the other competitors apart from the MAG. In 1958, in a dramatic boost to FN's overseas sales charts, the British armed services (including the Royal Navy, Royal Marines, and ground units of the Royal Air Force) adopted the MAG as their new standard support machine gun, which partly replaced the magazine-fed 7.62mm Bren and wholly replaced the Vickers.



The X15E1, the prototype of the L7A1 that was in British troop trials from the late 1950s until the official adoption of the L7A1 in 1961. (© Royal Armouries PR.239)



A skeletonized demonstration model of the L7A1. Note the silver gas piston in the cylinder beneath the barrel, plus the long return spring at the base of the receiver. (© Royal Armouries PR.7201)



The L7A2. The bipod is the original MG 193 A type, rather than the L2A1 type that became standard on the L7A2. The L7A2 continues in service to this day with the British Army, as its primary sustained-fire weapon when tripod mounted and fitted with the C2 optical sight. (© Royal Armouries PR.1270)

The British MAGs were license produced from 1961 by the Royal Small Arms Factory (RSAF), Enfield Lock, under the official series title of **L7 General-Purpose Machine Gun**. Affectionately known as the “Jimpy” (a twist on the “GPMG” abbreviation), the L7 has been produced in more than ten variants over its lifetime, to suit the British production conditions, and to adapt the weapon to different tactical roles and vehicular/aircraft platforms.



The L8A1 was a British version of the MAG developed for coaxial mounts in armored vehicles, principally for the Chieftain Mk 1 and Mk 2. The Chieftain Mk 1 had a single coaxial L8A1, while the Mk 2 had the coaxial gun by the side of the main armament, plus another mounted on the No. 15 cupola, fired by the commander. (© Royal Armouries PR.7204)

The initial British MAG was the **L7A1**, which was essentially a standard MAG 60.20. During the 1960s, the L7A1 was updated to create the **L7A2**. With this variant, the British began to make more significant changes to the weapon’s design. The changes included: mountings on the receiver to enable the fitting of a 50-round belt box; the fitting of a two-piece cartridge guide pawl; a ten-position gas regulator rather than the L7A1’s eight-position regulator; bipod legs with improved height adjustability; and the introduction of a plastic buttstock (although wooden stocks remain in evidence in early L7A2s). The modifications also included: safety improvements, specifically a special piston extension to guard against accidental discharge if the user lets slip the cocking handle during loading; improved chromium barrel lining; gas cylinder modifications to allow

the fitting of a heavy barrel; and an offset mount to enable the fitting of daytime and night-vision optical sights.

Beyond the L7A1 and L7A2 infantry weapons, the British MAGs have been adapted for many other purposes and contexts, not least in providing protection to the Army's large fleet of AFVs and infantry fighting vehicles. The principal coaxial variants were the **L8A1** and **L8A2**, fitted in the Chieftain and then Challenger MBTs. The L8A1 was solenoid fired and without buttstock and bipod, but it did have a folding pistol grip that could enable the gun to be manually operated in the event of an emergency. It also had a bore fume extractor fitted to the barrel, to prevent the interior of the vehicle being choked with propellant fumes. The L8A2 was largely like the L8A1, but with improvements made to the feed mechanism and different configurations of gas regulator (a single-switch open/closed type). While the L8 guns gave coaxial defense, top-mounted turret firepower was provided by the **L37A1** and **L37A2** variants. Essentially these were variants of the L8 equivalents, but with conventional pistol grips and trigger systems, for use by the vehicle commander or other crewman from the top of the turret. The L8A2 was also fitted with a belt-extraction lever that enabled the user to remove the belt without the need to open up the gun's top cover. In case the vehicle operators had to abandon the vehicle, but remain in the fight, these guns could be dismounted from the turret and fitted with an emergency egress kit, which consisted of a buttstock and bipod legs for ground use, plus an L7A2 barrel.



A British L37A1 vehicular variant of the FN MAG. Some examples of the L37A1 have the pistol grip and buttstock; this particular weapon is stripped down to its basics for a coaxial mount. (© Royal Armouries PR.7208)



March 2003: a British soldier stands guard on a Challenger 2 tank turret with an L37A2 machine gun during a training exercise at Camp Coyote, Kuwait. (Photo by Ian Waldie/Getty Images)

Another interesting variant for AFV use was the **L43A1**. This was actually designed as a ranging gun for the Scorpion light tank, the tracer ammunition for the L43A1 ballistically matched to the flight of the shell from the 76mm L23A1 gun. Other vehicular types of British MAG include the **L20A1** and **L20A2**, for use in remote gun pods, plus a Royal Navy variant of the L7A2, called the **L44A1**. These weapons are essentially the L7A2, but configured for remote pod firing (the L44A1 can also be fired manually) and fitted with an electrical safety mechanism that automatically prevents the gun firing accidentally as a result of vibration or knocks.



The L43A1 was mainly intended as a ranging weapon for the Scorpion light tank, although it could also be used in the full coaxial machine-gun role if required. (© Royal Armouries PR.9408)

Looking beyond land and sea warfare, the British also took the MAG to the skies. The L20A1 was adapted for a post-mount on a helicopter. It featured a regular L7 barrel but with an L8 gas regulator, plus it had an electrical trigger option and could be configured for either left- or right-hand feed. The most modern helicopter version is the GPMG ARD (Air Role Derivative) L112A1, fitted to Royal Air Force Merlins and Pumas. It is essentially an L7A2 machine

gun, being manually operated and with a full stock and pistol grip, with an aerial mount plus a fixed gas regulator.



The L20A1, designed for pod fittings or external mounts on helicopters and light aircraft. The L20A1 was fired electrically, hence the lack of a trigger group. (© Royal Armouries PR.9473)



The L44A1 is the Royal Navy's version of the L7A2, often pintle-mounted to deck rails or set in remote gun pods. The key features of the L44A1 are the Safety Unit L1A1 and the Electrical Firing Unit No. 1 Mk 1, the former preventing the weapon from accidental firing during stoppages. (© Royal Armouries PR.9373)

THE US M240 SERIES

The US armed forces also took a long, hard look at their machine-gun requirements following the end of World War II. In the US Army and Marine Corps, the Browning M1918 BAR and the M1919A6 weapons were replaced by the new American GPMG, the M60, in 1957. The M60 was, in its trial phase, actually pitted against the FN MAG as a potential rival. As we shall see, its victory over the MAG in the 1950s was not the end of the story.

The Americans also adopted, in 1959, a new gun as a coaxial weapon on their main battle tanks: the Machine Gun, 7.62mm, M73. Produced by General Electric, the M73 was configured so that even procedures such as barrel changes could be performed inside the vehicle. The gun was dogged by malfunctions, however, and even a significantly updated version, the M73/219, did not restore confidence in the system. As a result, from 1974 the US Army began to look around for a replacement.

The trials for the new gun were truly broad. The US authorities tested numerous types: the French AAT NF1, the FN MAG (in L7A2 format), the M60E2 (a coaxial version of the M60), the German MG3, the Canadian C1, and even the Soviet type PKM. Within a year only two guns were left standing – the M60E2 and the MAG. Now it came down to a simple challenge of reliability, and the MAG won through hands down, averaging 6,442 mean rounds between failure (MRBF – defined as a stoppage requiring more than a minute to clear) as opposed to the 2,962 MRBF of the M60E2. More about the reliability of the MAG during these trials is explained below, but the outcome was that in 1977 the MAG was accepted into US service as the new coaxial and pintle-mounted tank gun, designated the **M240**.

The adoption by the US Army and the US Marine Corps was a crowning victory for FN. (FN would go on to establish a major manufacturing arm within the United States, FN Manufacturing Inc.) The US MAG story would not end with the tank gun, however, which instead became the foundation for an extensive line of American machine guns, in much the same way as the MAG came to shape the British small-arms arsenal. For although the M60 had originally triumphed over the MAG as the infantry machine gun adopted in the 1950s, its performance and user-friendliness were thrown into doubt by actual combat use, despite several upgrades. During the 1980s, the US Army began to review its commitment to the M60, especially in light of the tactical and firepower options offered by another FN weapon, the 5.56mm Minimi, which would be adopted as the M249 Squad Automatic Weapon (SAW) in 1984. The SAW did not satisfy the MMG requirements, however, and in the 1990s the M60E4 was pitted against the **M240E4** – basically an infantry version of the M240 – in competitive trials. Again the legendary MAG reliability won the day, so in 1995 the US Army officially replaced its M60s with what was now called the **M240B**. Note that by this time the US Marine Corps had also taken on the M240 as a partial replacement for the M60 in infantry use. This gun was adopted in 1994 as the **M240G**, and was modified in true GPMG style so that the same gun could be placed on a variety of mounts, from bipods to pintle mounts.



A US Navy SEAL fires an M60E3 machine gun. The M60 is one of the MAG's principal rivals, although the American gun has not achieved anything like the MAG's international success. (PH1 Chuck Mussi/US DoD/Wikimedia/Public Domain)

The M240B and the M240G are the cornerstones of the US M240 series, but they are not simply reproductions of the original MAG weapons. The M240B includes an over-barrel heat shield (to prevent heat rising from the barrel distorting the sight picture) and a Picatinny rail atop the barrel for mounting various scope options. It also has a single gas setting, restricting the rate of fire to 650–750rd/min; on the original MAG, adjustment of the regulator to its higher settings could take the cyclical rate up to 1,100rd/min. Most significantly, however, the M240B included, from the early production batch, a new hydraulic buffer system of a type similar to that fitted in the M60. This reduced the felt recoil experienced by the user when delivering rapid fire.



In December 1990, a US Marine of the 1st Force Reconnaissance Company practices with a British L7A2 in the Saudi desert. (SSGT J.R. Ruark/US DoD/Wikimedia/Public Domain)



A Marine aboard an LAV-25 light armored vehicle holds onto the M240E1 machine gun mounted on the vehicle's turret while on patrol in Zakho, Iraq, in April 1991. (PH3 James R. Klein/USMC/Wikimedia/Public Domain)



A US Marine readies his M240G while providing security for a mission in Helmand province, Afghanistan, in May 2014. The gun is fitted with a TA648MGO-M240 6x48 Advanced Combat Optical Gunsight (ACOG). (Corporal Joseph Scanlan/USMC/Wikimedia/Public Domain)

The M240G, in classic US Marine Corps style, is a somewhat more basic variant. It does not have the forward heat shield or the Picatinny rail of the M240, and it also retains the original MAG buffer system. Instead of the M240B's single-setting gas regulator, it has a three-setting regulator system,

which gives the gunner the option of 650–750rd/min (setting 1), 750–850rd/min (setting 2), or 850–950rd/min (setting 3).



The M240L is a lighter and shorter version of the M240, with provision for accessories via the MIL-STD-1913 rail kit. (Photo Courtesy of PEO Soldier/Wikimedia/Public Domain)

The US forces have been investigating and deploying a new form of the M240B, the **M240L**. The rationale behind the M240L is to produce a lighter and less physically onerous version of the M240, by reducing the dimensions and investing in new material technologies, particularly the use of lighter titanium to replace some of the heavier steel operating parts. The barrel length is also reduced compared to that of the standard M240B, and the gun has been fitted with a collapsible stock. Total weight savings are in the region of 4.4lb, and the weapon entered operational testing with US Army and Special Operations Command units in 2010. It has been enthusiastically received, with US Army orders for 12,000 of the guns. There is even a planned lighter version, the **M240P**, although at the time of writing that is only just entering the testing phase. (Similarly, in June 2012 Heckler & Koch demonstrated a new **Lightweight L7A2** intended for the British forces.)

The vehicular versions of the M240 also went through an evolution from the original coaxial variant. First came the **M240C**, which was used in the M2/M3 Bradley Infantry Fighting Vehicle, the Light Armored Vehicle, and M1 Abrams MBT. The M240C can be adapted to either left- or right-hand feed, depending on the layout of the vehicle, and it also has charging-cable cocking plus a trigger that is solenoid activated via a paddle assembly.

Note that the M240 coaxial gun also came with a Ground Mount Adaptation Kit (GMAK), which enabled the weapon, once removed from the vehicle mount, to be converted into a basic infantry machine gun. The FN-produced kit included a unit attached to the lower receiver by a single pin fitting, providing the

underside of the M240 with folding bipod legs, a bandoleer hanger feed mechanism, plus a folding tubular buttstock. The M240, thus configured, would not have much in the way of sophisticated sighting mechanisms, relying purely on its basic receiver-mounted iron sights, but it would be sufficient to keep the tank crew firmly in the fight.

For aircraft use, there are the **M240E1** and **M240D** variants, the latter being an upgrade of the former, with the fitting of an optical rail on the receiver cover. Both weapons have a spade grip configuration. Should either weapon require conversion to an infantry weapon, in extremis, it can be modified to the “Egress” configuration through the application of the Infantry Modification Kit (IMK), which is in essence much like the GMAK. The IMK consists of a buttstock, pistol grip, flash suppressor, front sight and rear sight assembly, barrel-carrying handle, and a bipod. The improved version of the M240D is the **M240H**, which has a rail-equipped feed cover and a new type of flash suppressor, plus improvements in its ability to convert to a ground weapon.

The M240 series has been enormously successful, as indicated by the continual investment in its future, which usually suggests that the fundamental design of the weapon is reliably sound. The same can be said of virtually any of the MAG types in use with the dozens of users around the world, from the Canadian **C6** series to the Taiwanese **Type 74**. As we go on to look at the practical use of the MAG, both in terms of its physical operation and also its tactical applications, we will come to a deeper understanding of just what it is that has made the MAG such a worldwide success.



March 2008: a US soldier aboard a Boeing CH-47 Chinook helicopter mans his M240H while flying between Kabul and Bagram, Afghanistan. (PAUL J. RICHARDS/AFP/Getty Images)



USE

Reliability under fire

OPERATING THE FN MAG

Firing a machine gun for the first time is an exhilarating experience, at least when done under peacetime conditions. With the stock gripped, sights trained on the target, and a long belt of ammunition snaking into the feed aperture, a concentrated stillness seems to infuse the surrounding air in the moments before the trigger is pulled. The stillness resonates because you know it is about to be rent apart.

When the moment comes, and the striker hits that first round in the belt, the experience is best described as “controlled violence.” There is the rapid rhythmic thumping of the stock in the shoulder, the belt sprints and scrapes into the feed tray, empty cartridge cases spiral hot through the air and chime on the ground. Above all there is the noise – raw and deafening, synchronized with (if the light is low) a strobing muzzle flash, and accented by the spreading cloud of propellant fumes. The steel is energized with heat, especially the barrel. Then, of course, there is the impact on the target which, for my first experience, was a classic wooden cut-out of the running soldier. It was sawed to pieces in seconds, wood splintering to dust and shards, and bullets flying through and beyond to bury themselves deep in the earth berm behind. For those few seconds of firing, I certainly felt both utterly energized and powerful.

Of course, experienced soldiers reading this book will recognize the wide-eyed zeal of a civilian being introduced to a machine gun for the first time; but for those who take a machine gun into combat, the experience is far more nuanced. Certainly, a machine-gun operator is always aware of the immense tool for violence he holds – but he has to think of far, far more if that tool is to be used effectively. For example, as soon as a machine-gunner lets rip, he, his team, and his weapon become the primary target for almost all enemy infantryman within range, who will typically open up with everything they have on the machine-gun position, unless they can be kept suppressed. So tactical awareness is key. Nor can all but the lightest machine guns be moved easily from position to position.

One of the critical factors in the survivability of the machine-gunner and his team is a complete familiarity with their weapon. Under firefight conditions, the gunner should be able to load, aim, fire, and control the MAG with complete fluidity. The techniques of doing so, plus the mechanical actions of the gun itself – which also need to be fully understood by the gunner – are now our subjects of focus.

LOADING AND FIRING

Operation of the MAG begins, naturally, with loading the gun. To insert a new belt, the gun's top cover is raised with the gun canted over to the right. The belt is then inserted into the feed tray, with the links of the belt facing upward and the first cartridge in the belt resting against the cartridge stop. While the gunner (or gunner's assistant) holds the belt in place with a hand, the top cover is then snapped shut. The first cartridge in the belt is now aligned with the chamber, while the second round is held in the outer pawls of the feed mechanism.



A British paratrooper with 2nd Battalion, The Parachute Regiment puts down covering fire with his tripod-mounted L7A2 during Operation *Oqab Tsuka* at Kajaki Dam, Afghanistan, in August 2008. (Photo: Sgt Anthony Boocock, RLC/MOD/Wikimedia)

The MAG is an open-bolt weapon, meaning that when the gun is cocked the bolt is held at the rear under the pressure of the return spring, rather than being closed up to the breech. The advantage of such a system is primarily related to cooling; by having the bolt held to the back, cooling air can flow through the barrel and around the bolt face and breech, helping the gun to lose its heat between periods of firing. The gun is manually cocked by pulling back the cocking handle on the right side of the receiver, this action drawing back the gas

piston and the breech block against the rising tension of the return spring. At the moment of cocking, the spring-loaded ejection port cover on the receiver of the gun also lifts, to allow the ejection of spent cartridges. As the pistol mechanism and the bolt group reach the rear of their travel, the sear rises up and locks against the sear notch beneath the piston extension, holding the working parts of the gun to the rear. Note that the cocking handle should now be returned to its front position, to ensure that the gun is fully and properly cocked.

The gun is ready to fire. When the trigger is pressed, the sear is drawn down and disconnects from the sear notch, releasing the piston and the breech block under the tension of the return spring. Feed horns on the bolt catch the first cartridge and push it forward out of the belt and into the chamber of the gun, a cartridge guide ensuring that the case moves in the right direction. As the 7.62mm cartridge is pushed into the chamber, the extractor hooks itself over the rim of the cartridge, while the ejector is also compressed under spring pressure.

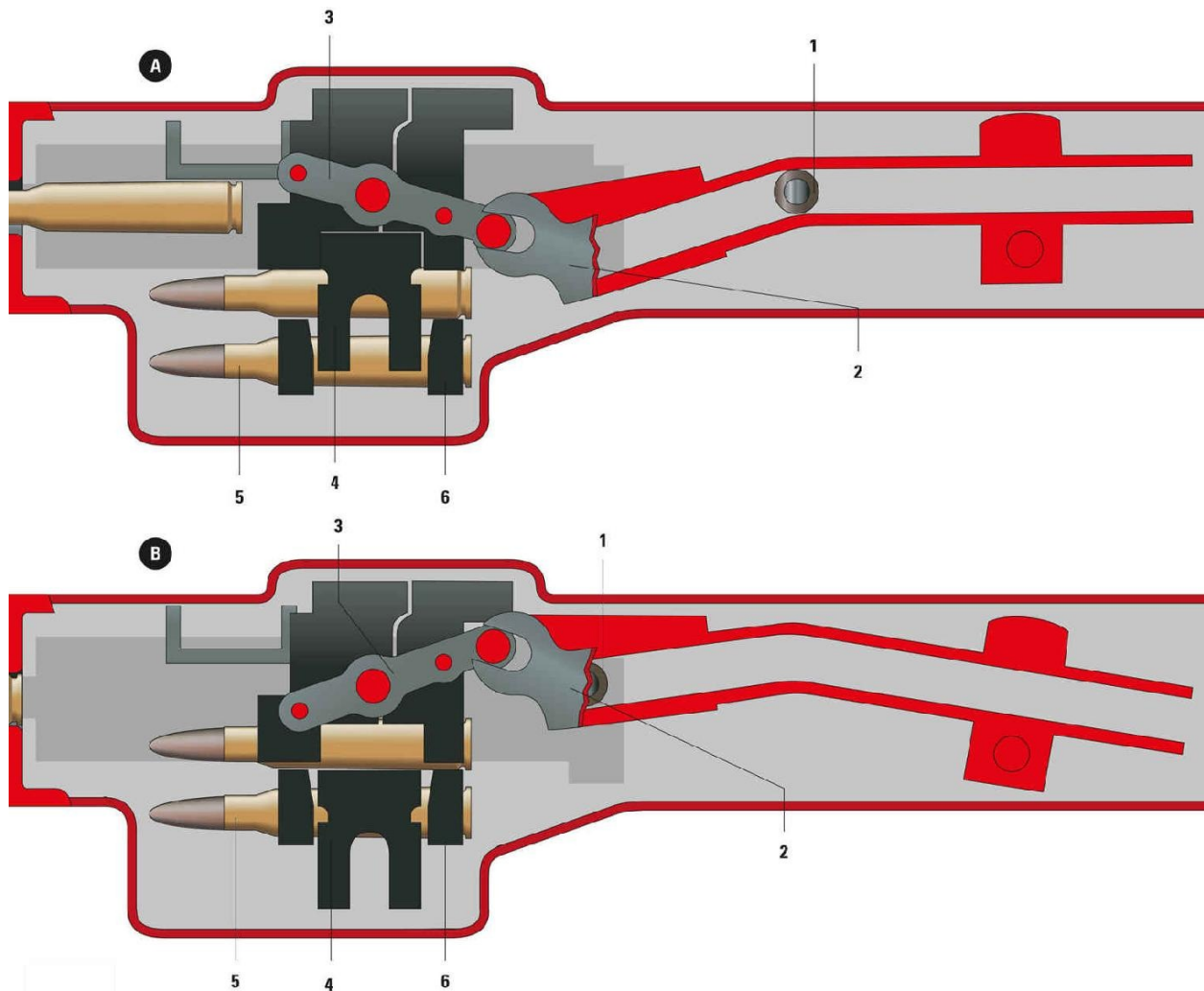
The bolt group needs to be securely locked before the gun is ready to fire. This is achieved via an articulated locking lever connected to the rear of the bolt carrier. As the working parts move forward, locking cams drive the lever downward, first slowing the movement of the breech block and then forcing the locking lever to engage with the locking shoulder in the rear of the receiver. At this point the cartridge is fully seated, the breech locked, and the gun ready to fire. As the piston extension performs its final forward movement, it drives the firing pin, which runs through the center of the bolt, into the percussion cap of the cartridge, and the gun is fired.

The MAG is a gas-operated gun, meaning that the gas produced by the propellant gas is used as the motive power for cycling the weapon's action. As the bullet passes the gas port near the end of the muzzle, a portion of the gas is channeled down through the port and passes into the gas cylinder that runs parallel to the barrel. Note that, depending on the specific model of the MAG, the actual quantity of gas used to power the action can be controlled by adjusting the gas regulator. This regulating device essentially serves two mechanical functions. The first is to control the MAG's rate of fire. The more gas that is allowed to flow into the cylinder, the greater the pressure, hence the faster the rate of fire. The general range of the MAG's cyclical rate is 650–1,000rd/min. The regulator can also be a useful device to improve the performance of a gun that is starting to feel the inertia of dirt build-up in the mechanism, during intensive firing. If there is not the opportunity to do a quick field strip and clean,

the gunner can open the regulator a little more, giving additional motive force to override the resistance building up around the moving parts.

As the propellant gas enters the gas piston, it impinges on the piston head, driving the piston and piston extension to the rear. Note that for the initial part of its travel, about .59in, the piston extension does not move the breech block, which remains locked in place to allow the bullet to pass out the gun and for the pressures to drop to a safe level. The firing pin, however, is withdrawn into the breech block off the spent cartridge case. As the piston extension maintains its rearward movement, the locking-lever link is rotated forward and upward, lifting the locking lever out of contact with the locking shoulder, in turn unlocking the breech and allowing the breech block free movement to the rear.

As the breech now starts to move backward, in sympathy with the piston and piston extension, the extractor draws the case out of the chamber and, when the case is clear of the breech, the extractor in the bolt face pushes the case away from the breech block face and ejects it downward through the ejection port underneath the receiver. (The ammunition belt chain link detaches from the rest of the belt and is also ejected from a small link ejection port.) Now the breech block and piston mechanism keep moving to the rear of the gun against the pressure of the return spring, and rebound off the buffer. If the trigger is still pressed down, then the piston, piston extension, and breech block will now effect a rapid return forward, stripping off another cartridge and beginning the firing sequence once again.



These illustrations depict the feed mechanism. In diagram **A**, a belt of ammunition is positioned in the feed tray, with the gun cocked and the bolt to the rear. On firing, when the piston mechanism has moved forwards about 3in, the feed actuating stud (1) begins to move the feed arm (2); the stud runs in the feed arm track. The movement of the feed arm is transferred to the feed pawls via an actuating arm (3). In diagram **B**, further forward movement causes the forward end of the feed arm to be forced to the right. The inner feed pawl (4) moves to the left and engages the next cartridge in the belt (5). At the same time, the outer feed pawls (6) carry that round from left to right to the “half-feed” position. Both inner and outer feed pawls are therefore engaged with the round. During the subsequent rearward travel of the breech block, after firing, the feed actuating stud moves the forward end of the feed arm from right to left, and at the same time the inner pawl moves to the right, carrying the cartridge from the half-feed to fully fed position. The outer pawls, meanwhile, are shifted to the left to engage with the next round in the belt.

M240 – loading and firing

WARNING

Under no circumstances should the safety be engaged with the bolt in the forward position.
Place safety to “F” fire.

Pull charger cable (or cocking handle assembly) to rear, and ensure bolt locks to rear. Release charger cable (or return cocking handle assembly) to fully forward and locked position.

Place safety to "S" safe.

Push in latches to open cover assembly. Remove any ammunition if present.

Raise feed tray. Look into chamber, make sure no round is chambered and area is free of obstructions. Lower feed tray.

Place safety to "F" fire.

Pull and hold charger cable (or cocking handle assembly) to rear, squeeze trigger and ease bolt forward to close and lock.

NOTE

Position open side of links down.

Place link belt in feed tray with first round positioned against cartridge stop.

CAUTION

Make sure round does not move away from cartridge stop during closing and latching of cover.

Close cover assembly. Make sure it locks shut. (Air Force users, this is HALFLOAD and is an authorized carry/transportation configuration of the M240B and its ammo.)

Pull charger cable (or cocking handle assembly) to rear, and ensure bolt locks to rear. Release charger cable (or return cocking handle assembly) to fully forward and locked position.

If weapon is not to be fired immediately, place safety to "S" safe. Place safety to "F" fire immediately prior to firing. (Air Force users, this is FULL-LOAD/COMBAT LOAD configuration.)

NOTE

Proper trigger control is pulling the trigger fully to the rear and then releasing completely. Squeezing the trigger can cause accelerated wear on the trigger tripping lever, sear and operating rod, leading to a run-away gun. (US Department of Defense 2002: 0009 00-1-0009 00-4)



A US serviceman loads a belt of 7.62mm ammunition into his vehicle-mounted M240B, pushing the lead cartridge up to the belt stop. Note the belt-feed actuating lug just behind the first cartridge. (Lance Cpl Austin Lewis/USMC/Wikimedia/Public Domain)

RELIABILITY

Although mechanically complex to describe, the MAG's feed system is nevertheless rugged and efficient. Failures to feed are often more likely to be due to problems in the ammunition or the belt. Indeed, the MAG cannot be discussed meaningfully without addressing its legendary reliability, which is one of the key reasons it has stayed so central to military arsenals around the world for so long.

Of course, the reliability of any gun is partly dependent upon the careful maintenance and operation of the weapon by the gunner. For example, even though the MAG's heavy barrel, which weighs 6.72lb on the standard model, and its robust operating mechanism, can soak up much of the heat of firing without problems, the gunner still needs to keep a constant check on the weapon to guard against overheating. Ignoring this issue, and delivering uncontrolled sustained fire over a period of several minutes, can result in a range of gun-stopping maladies, including "cook-offs" (the spontaneous firing of cartridges in the overheated chamber), degraded accuracy, and the weakening and breakage of critical parts, such as the firing pin. The basic rule of thumb for MAG gunners is that when delivering sustained fire at a rate of 100rd/min, with 4–5 seconds between bursts, the barrel should be changed every ten minutes. If more rounds are going downrange each minute – 200rd/min with 2–3 seconds between each burst is classified as "rapid" fire – then the barrel changes need to be performed every two minutes. (The subject of fire discipline and barrel overheating is discussed in detail below.) Fortunately, the barrel-change system is simplicity itself. The barrel is removed by pressing a release latch on the gun body, then rotating the barrel counterclockwise, an action that releases the barrel from the receiver and the gas-piston unit. A new barrel is fitted to the gun by putting it into place, then using the handle to rotate it clockwise, the user listening for a total of seven clicks to indicate that the barrel is seated properly. In the hands of an experienced gun team, and with a new barrel sitting ready by the side, the operation takes just a few seconds to perform before the MAG is back in business.

The gunner also needs to be diligent in his cleaning and maintenance regime. Oiling must be thorough but light; over-oiling attracts dust and results in clogged-up or worn parts. The gas-regulator apertures and piston parts, and the feed and firing mechanisms, must be kept clean and free from dirt, by virtue of regular field stripping. As the British Army's 1966 *Infantry Training Volume 1: The General Purpose Machine Gun (Light Role)* manual attests, stoppages

should be rare if the weapon is cleaned and prepared appropriately (MOD 1966: 32).

Even so, this being the real world, stoppages will occasionally occur in any gun, even one as emphatically reliable as the MAG. The majority of MAG stoppages actually derive from problems with the ammunition belt, rather than the gun itself. Issues causing such stoppages include damaged rounds, damaged belt links, and defective cartridges that fail to fire. These stoppages can be dealt with promptly by using what the British Army terms the “immediate action” (IA) drill. First, the weapon should be cocked; this may result in a misfired round being extracted and ejected. If the weapon cannot be cocked, a damaged belt link may be obstructing the feed pawls. The gunner then lowers the butt before opening the cover; the feed tray is cleared and the cover is quickly closed again. The gunner raises the butt, aligns the sights and fires the weapon, before once again lowering the butt, reloading, cocking the weapon, and resuming firing (MOD 1966: 33).

This procedure should get the gun up and running again. If it fires but jams again quickly, then it could be that the gun is dirty and there is insufficient gas running through to cycle the mechanism. In this case, a “gas stoppage” drill is the answer. The gun is once again cocked, but this time the safety is engaged. The British Army manual then recommends that the gunner uses the regulator to increase the supply of gas, employing the tip of a bullet to turn the regulator if it is too hot to touch with bare hands (MOD 1966: 34). Beyond belt feed and gas stoppages, MAG malfunctions can include broken internal parts, but these are rare.

A striking insight into the MAG’s fundamental reliability comes from a fascinating document (B-186276) released by the Comptroller General of the United States on August 20, 1976. The context of the document was a complaint issued by Maremont Corporation (Maremont) of Saco, Maine, against the adoption of the MAG 58 as the replacement for the coaxial M219. The document argues in detail against the complaint, closely citing the technicalities of the evaluation procedure. Specifically, it looks at how the MAG 58 fared in tests alongside the M60E2 against which it was competing. The comparison is interesting, because it shows the MAG pitted against another 7.62x51mm NATO weapon that garnered a reputation, at the time, for *unreliability*. Just how unreliable in comparison to the MAG is revealed in document data, and it is worth quoting at length from the document to show both the criteria for evaluation and the results of the trials:

On August 19, 1975, a set of technical and performance characteristics (Required Operational Capability (ROC)) were developed. The planned MAG58–M60E2 side-by-side test results were to be judged against the ROC. The comparative testing of the MAG58 and M60E2 consisted of an operational test (OT III) and a development test (DT III) conducted by independent Army activities. In view of the “off-the-shelf” requirement, the Army procured coaxial machine guns, which were essentially production line weapons, from FN and Maremont for the tests. The tests were designed to be comparable to the earlier M60(MOD) OT II tests. The OT III was essentially a field test designed to simulate the operational environment in which the weapon would be utilized. This test was performed with operational troops using their organic tank equipment. The OT III was intended to provide data concerning the relative operational effectiveness and military utility of the weapons. Weapon reliability was the primary concern of this test. The primary statistical data to be obtained from the OT III were mean rounds between stoppages (MRBS) and mean rounds between failures (MRBF) based upon the firing of the first 50,000 rounds. (100,000 rounds were scheduled to be fired.) A stoppage includes actual unintentional cessations of firing as well as potential stoppages, e.g., potential weapon failures found during nonfiring activities. A failure is defined as a stoppage lasting more than 1 minute.

As a result of the OT III, the MAG58 proved to be about 3.5 times as reliable as the M60E2, as indicated by the following table:

	MRBS	MRBF
M60E2	846	1699
MAG58	2962	6442
ROC minimum	850	2675
ROC preferred	1750	5500

OT III data indicated other relative strengths and weaknesses in the two weapons. For example, the rivets located alongside the MAG58’s receiver broke between 30,000 and 50,000 rounds. Also, the MAG58 receivers developed cracks between 66,000 and 75,000 rounds. The DT III was an engineering test using standard test procedures and experienced test technicians. One primary purpose of the DT III in this case was diagnostic, e.g., to determine the causes of failures and stoppages. Factors such as endurance, reliability, accuracy, safety, barrel performance, rate of fire (ROF), effect of varying environmental conditions and other engineering subtests were also evaluated under laboratory test range conditions. The DT III tests indicated that the MAG58 was about 2.5 times as reliable as the M60E2 for the first 50,000 rounds fired. Also, the MAG58 had a higher ROF (in excess of the ROC’s stipulated ROF) and was more reliable during sand and dust, and corrosive tests. The M60E2 barrels were considered superior to the MAG58 barrels during high rates of sustained fire. (CGUS 1976: 5–6)

The test results could not attest more emphatically to the qualities of the MAG 58; it is important to remember that the tests were using off-the-shelf guns, not weapons specially prepared for the testing and evaluation process. The MRBS and MRBF figures are massively weighted in favor of the MAG, but they are in no way compromised by the recognition that the MAG receivers suffered

some material defects after huge numbers of rounds were put through the gun. Although the M60 has remained in service, by virtue of some judicious updating, it has never quite risen to achieve the status of the MAG.

The test figures are quite “dry” in their presentation, but we should be in no doubt that the MAG’s reliability is a real-world selling point. Combat reports coming back from the field tend to be glowing in their praise for the MAG, not least because soldiers have come to regard it as completely trustworthy at those moments when a mechanical failure could have mortal consequences. In July 2003, for example, a US Army study group known as the Project Manager Soldier Weapons (PMSW) produced a report entitled *Soldier Weapons Assessment Team Report 6-03, Operation Iraqi Freedom* (OIF), in which they presented an assessment of the weapon systems used by US soldiers during the OIF campaign to date. Iraq proved to be a particularly harsh environment for small arms. Its atmosphere is frequently clouded with a fine penetrating dust, which during OIF worked its way into firearms operating parts, jamming guns at moments of frantic inconvenience. The climate was also baking hot, leading to gun overheating. Furthermore, the levels of violence and the intensity of firefights meant that front-line soldiers were testing guns to the very limits of their material endurance. Out of this punishing field laboratory, the MAG, in its M240B variant, emerged as a clear winner among the troops:

The Iraqi desert was very challenging and harsh, but the current weapons, ammunition and accessories the soldiers took to battle functioned, withstood the elements and were lethal. The weapons that stood-out were the M2 HMG, M240B MMG and the M4 MWS. The M2 HMG and M240B MMG were praised mostly for their ruggedness and reliability. The weapon’s reliability was most important to the soldiers. (PMSW 2003: 4)

Here the M240B takes its place alongside the M4 Carbine and the M2HB among the US forces’ most trusted firearms. Other reports from the same theater, and from Afghanistan, largely come to the same conclusion. It should be noted, in balance, that other weapons are given more adverse scrutiny, such as the M249 Squad Automatic Weapon (SAW); such reports are by no means simply rubber-stamping standard-issue weapons.

Looking back across the MAG’s history, the same confidence surrounding the weapon becomes evident time and time again. A good example is provided by an article entitled “Belgium’s MAGnificent MG” by Peter G. Kokalis, featured in a 1985 edition of *Soldier of Fortune* magazine (Kokalis 1985). Kokalis reflects upon the gun’s technical complexity, but goes on to note that this complexity does not detract from its fundamental reliability, which is akin to that ascribed to

legendary workhorse weapons such as the AK-47. It does indeed appear that if the MAG is properly maintained, and fed with high-quality ammunition in a correctly loaded and undamaged belt, there is little to go wrong with it.

Describing in detail all the various mounts and sights that accompany the MAG and its derivatives would take almost a book in itself, so only key examples and general principles are described here. Yet rather than consider the mounts and sights from a purely technical vantage point, it is important to think of them in their tactical context. We return here to the principle of the MAG as a general-purpose machine gun. Here we must think of gun, mount, and tactics working in unity. For while the gun itself is the business end of the arrangement, it only realizes its potential when it works in tandem with the system by which it is mounted and a gunner who knows how to handle it in that configuration. Before doing so, we should establish some of the basic performance parameters of both the gun and the ammunition that it fires.

US Army Advice – M240B oiling and preventive maintenance

3-71. Remember the following important points during cleaning: Avoid using gasoline, kerosene, benzene, shaving cream, high-pressure water, steam, or air for cleaning. Keep the gas hole bushing free of CLP [Cleaner, Lubricant, Preservative] or RBC [Rifle Bore Cleaner]. It must remain dry. During sustained fire, especially with blank ammunition, you must periodically strip and clean the extractor assembly. An improperly cleaned gas cylinder and gas regulator plug can stick together during firing.

Lubricate the following parts with CLP as instructed:

- Drive-spring rod assembly.
- Bolt.
- Receiver inner walls.
- Cover assembly (springs, and feed pawls).
- Trigger housing (inside only). After you lubricate the weapon, cycle the components by hand to spread the CLP. If you fire a weapon infrequently or store it for prolonged periods, keep a light film of CLP on it. Apply it to the inside of the gas cylinder and to the gas piston right after you clean or inspect the weapon.

Do preventive maintenance every 90 days, unless your inspection reveals a need for more frequent servicing. Even when you keep a weapon lubricated, you must still clean and inspect it for corrosion. Before you use the weapon, clean the gas system and components, and ensure they are free of oil and lubricants. Clean all exposed surfaces of the M122A1 tripod, flex-mount assembly, and complete pintle and T&E [traverse and elevation] mechanism. Wipe them down with a clean rag. Loosen dirt in stubborn areas (except the flex mount) with a steel or bore brush. Use a clean rag to wipe them down. Finish by lubricating them with CLP.

In unusual conditions, clean and lubricate the M240B as follows:

- Below 0 degrees Fahrenheit – use lubricating oil, arctic weather (LAW). Oil lightly to avoid freeze-up.

- Extreme heat – use light coat of CLP.
- Damp or salty air – use CLP. Clean and apply frequently.
- Sandy or dusty areas – use CLP. Clean and apply frequently, and wipe with a clean rag after each application to remove excess.

M240B Machine Gun (US Army 2006: 3-24-3-25)



A US Marine Corps machine-gunner aboard the amphibious assault ship *USS Makin Island* (LHD-8) disassembles an M240, drawing out the breech block and operating-rod assembly from the rear of the receiver. (US Naval Forces Central Command/US Fifth Fleet/Wikimedia/**CC BY 2.0**)

AMMUNITION AND FIRE DISCIPLINE

If we take the MAG in its modern US/NATO context, the two main types of ammunition it fires are the **M80** (or Belgian M77) ball round set in a 4-to-1 combination with the **M62** tracer. The M80, in combination with the 24.80in barrel of the M240B, delivers a 146-grain (.33oz) bullet (a soft lead core coated in a gilding copper jacket) at a muzzle velocity of 838m/sec (2,749ft/sec). The M62 tracer provides the gunner with a visual guide of his bullet flight and impact point, and also delivers incendiary effects on flammable targets. The tracer effect is provided courtesy of composition R 284, which is 17 percent polyvinyl chloride, 28 percent magnesium powder, and 55 percent strontium nitrate. A gunner using tracers must exercise caution in assuming that the path of the tracers faithfully follows that of the ball rounds. In fact, as the tracer bullet burns through its incendiary composition, the bullet as a whole loses mass, which causes it to slow more quickly than the ball rounds, especially as the range stretches outward. For this reason, at long range the gunner might have to judge the ball round impact point as slightly higher than that of the tracer rounds. With the M62 round, tracer burnout is around 1,000m (1,094yd).



The last rounds of a belt run into a GPMG handled by a soldier of A Company, 3rd Battalion, The Parachute Regiment, during a British training exercise in Kenya in February 2010. (Photo: Cpl Rupert Frere RLC/MOD/Wikimedia)

Given that material destruction is one of the key desirables in a machine gun, penetration is critical to the MAG's effect on target. With the standard M80 ball round, the MAG will maintain its lethality against an unprotected human target out past 3,000m (3,281yd), but will penetrate .14in of steel plate at a range of 600m (656yd). At 200m (219yd), the rounds pose a serious danger even to enemy who feel they have found decent cover. At this range, the MAG will be

able to punch through 40.98in of pine board, 6.81in of dry loose sand, 7.99in of cinder block, and 2.01in of concrete block; and these are just single-round figures – remember that one of the characteristics of machine-gun fire is that the incessant following impacts of the rounds will “eat” through the target to the other side, unless the material is “self-adjusting” to the impact, such as a sandbag. (In fact, a densely packed and damp sandbag remains one of the best defenses against small-arms rounds.) Thus an enemy hiding behind single-layer brickwork, the plasterboard partitions of interior rooms, light vehicle bodywork, or all but the thickest tree trunks is essentially behind concealment, but not behind cover, if someone is firing a MAG. Realistic cover from the MAG is best provided by sandbags, steel-reinforced concrete structures or thick stonework, or behind some significant natural feature.



A US Marine Corps machine-gun team prepare a belt of ammunition for an M240. Note the spare barrel, complete with heat shield, in a barrel bag to the side. (Lance Cpl Dani Zunun/USMC/Wikimedia/Public Domain)

The penetration of the MAG can be improved by using armor-piercing ammunition. The two main types of armor-piercing 7.62mm cartridge in the NATO arsenal are the **M61** (identified by a black tip to the bullet) and the much-improved **M993**. (Note that all the cartridge types explained so far are not used exclusively in MAG-type weapons, but in several varieties of belt-fed machine guns and also some precision rifle types, such as the modern M21.) The M61 bullet weight is 150.5 grains (.34oz) and that of the M993 is 126.6 grains (.29oz). In overall design, the bullets of these cartridges follow basically the same principles, with a penetrator wrapped in a copper jacket; the M61 uses a

hardened steel penetrator, the M993 a tungsten penetrator. The M61, which leaves the muzzle at roughly the same muzzle velocity as that of the ball round, delivers improved penetration against hardened targets, going through .20in of armor plate at 500m (547yd). The Bofors-made M993, however, offers the gun team even greater penetration, by virtue of its harder, reshaped penetrator plus an enhanced muzzle velocity of 910m/sec (2,986ft/sec). Its armor penetration at 500m is .28in.



Irish Defence Forces troops conduct a training exercise with a MAG. The blue components likely indicate that the weapon is a training tool, further suggested by the fitting of the blank-firing adapter. (Irish Defence Forces/Wikimedia/**CC BY 2.0**)



British soldiers sit back and study a smoking L7A2, its barrel super-heated by prolonged bursts of heavy fire. Continued firing would require either a barrel change or a wait for the fitted barrel to cool. (US Army Europe Images/Wikimedia/[CC BY 2.0](#))

The basic message of all these figures is that an enemy anywhere within 3,000m (3,281yd) downrange of a MAG-type weapon needs either to be well protected behind cover, or well out of the line of fire. For the gun team, however, there is also the issue of delivering their fire in a sustained way. Of the total amount of energy expended when a bullet is fired from a gun, only about 30 percent is actually imparted in the form of kinetic energy behind the bullet. Even with a thick machine-gun barrel fitted, any sort of sustained fire will quickly heat up a barrel until it can reach temperatures in excess of 750°F. Should temperatures climb higher, to around 930°F, then the barrel can start to experience structural damage, “burning out” the rifling and affecting the barrel’s accuracy. The other problem is that of “cook off,” in which cartridges are detonated purely by the excessive heat in the chamber setting off the propellant. Such a situation is naturally dangerous to the users.

With the MAG, there are two ways in which the user can control barrel heating: controlled and sensible patterns of fire, and barrel change. The former is the product of good training in the form of emotional discipline (to avoid overexcitement producing excessive bursts in combat conditions). A useful guide to what is appropriate, depending on the target type, can be found in the British Army manual *Infantry Training Volume 1: The General Purpose Machine Gun (Light Role)*. It recommends an initial burst of 3–5 rounds, with the gunner taking care to observe the fall of shot as closely as possible, with both eyes open, before adjusting the sights or aim to allow for range, wind, and other factors.

Every fifth round should be tracer. The gunner should then resume firing at a rate of 25rd/min; burst length should depend on the nature of the target, the range, and other variables. Rapid fire – specified as being around 100rd/min (no more than that during training), and defined as the maximum rate of fire at which accuracy can be maintained – should be reserved for particular targets or situations, in order to avoid overheating the barrel, incurring dangerous stoppages, or wasting ammunition. If rapid fire is required, the gunner should take advantage of any lull to unload the weapon, cock it, and raise the cover to facilitate cooling (MOD 1966: 29). The manual mentions the alternating use of one eye/both eyes for aimed firing and observed impact, and the utility of longer bursts for tackling AFVs (the multiple rounds raising the possibility of shattering the vehicle's external equipment or passing through a vision slot to hit an occupant). But the central message is clear: fire should ideally be controlled in 3–5-round bursts, with spaces in between for cooling. In extremis, the gunner can increase the rate of fire to bursts of 5–8 rounds, or even longer if the situation demands it, but this is not to be recommended.

Modern US armed services advice relating to the M240 gives similar procedural guidelines. Official classifications of “sustained fire” for the M240B (and the M60) are 100rd/min in bursts of 6–9 rounds, with pauses of 4–5 seconds between the bursts. If this rate is sustained, then the barrel needs to be changed every 10 minutes. “Rapid fire,” however, is defined as 200rd/min in bursts of 10–12 rounds, the interval between the bursts reduced to 2–3 seconds. This produces what is known as a “hot gun,” i.e. one that has reached the level at which it might experience mechanical malfunction. The “hot gun” definition can actually apply to any M240 that has fired 200 rounds within a two-minute period, or if the gun has ripped through a particularly long continuous burst, such as 60 rounds, even though the weapon has not expended 200 rounds in total.

Fire discipline in terms of bursts is not just a matter of controlling the MAG's temperature, however. It also serves to conserve ammunition – the gun team might only be carrying 500 rounds in total, in 250-round sections (less if the gun team is in a highly mobile assault role). Taking into account the aforementioned calculations, it is easy to see how the undisciplined gunner could burn through an entire ammunition supply in short order. There is also the tactical consideration that it is harder for an enemy to identify the position of an enemy machine gun if that weapon is firing in short bursts, with pauses in between, especially if those pauses are filled by the cacophony of gunshots from other

weapons. A long rippling burst will give the enemy auditory and, often, visual references for the machine-gun position, which will then typically suffer the full firepower of whatever weapons the enemy can bring to bear.

That having been said, we must always allow for the psychological and tactical realities of combat, when the textbook recommendations do not fit with the immediate experience of battle. A good example of this in action, applied to an M240, is found in the book *My War: Killing Time in Iraq* by Colby Buzzell, a US serviceman who fought in Iraq. Buzzell recalls one engagement in which he continued to fire his M240B at a building in a sustained burst that only ended when he reached the end of the ammunition belt (Buzzell 2006: 160–61). The sheer exhilaration of battle resulted in Buzzell nearly burning out the barrel, although his account does reveal a discipline in the fire, the serviceman noting that he shifted methodically from window to window. Given that he was delivering 3–4-second bursts, each burst probably consisted of about 50 rounds of fire. Such rates of fire are also probably indicative of a military force for whom logistics and ammunition supply is not a problem. Of course, when the barrel does become too hot, it can be changed easily – the entire procedure can be performed in as little as four seconds by a well-trained crew.



This M240 in Iraq has been fitted with a dazzler device, used to blind potential aggressors temporarily and employed in Iraq to enforce vehicle stops. (Dainomite/Wikimedia/[CC BY 3.0](#))

Rhodesian Light Infantry, 1978

On a forward base near the Rhodesia/Mozambique border, soldiers of the Rhodesian Light Infantry receive training in FN MAG operation and firing. During the Bush War of the 1970s, the MAG provided Rhodesian troops with a portable form of heavy firepower that could be deployed for responding to, or delivering, ambushes and for putting down heavy suppressive fire when required, one gun being integral to each four-man patrol “stick.” The sweltering African heat imposed some adaptations of normal procedure. Each gunner carried about 500 rounds of belted ammunition, but he would often fire only 50-round sections – the shorter sections of belt were less liable to snagging on the surrounding brush, especially if the gunner had to fire the weapon from the hip. It was also common for the gunner to omit carrying a spare barrel, to avoid the weight increase, so he would have to control his fire carefully.

On the table, an FN MAG has been stripped down into its essential component parts for instruction on cleaning and operation: barrel, gas piston and breech block, receiver, return spring, pistol grip and trigger group, and stock. To the left of the gun parts is the standard tool roll, denoted in British nomenclature as Roll Tools and Accessories 7.62mm MG L1A1. Standard contents of this roll were: Rod Cleaning SA L1A1; Plastic Bag 52mm×150mm; Plastic Bag 175mm×180mm; Cleaning Tool SA No. 2 Mk 1; Extractor SA Cartridge; Plunger Extractor; Spring Extractor; Link Pin; Collar Split; Extractor Ruptured Cartridge 7.62mm Mk 1; Oiler Hand No. 1 Mk 1; Brush Cleaning SA No. 3 Mk 1; Brush Cleaning SA 7.62mm L15A1; Brush Cleaning 7.62mm Chamber and Gas Cylinder Mk 1; Adjusting Tool SA No. 1 Mk 1; Pin Rear Mounting 7.62mm MG Mk 1; Cleaning Tool SA No. 4 Mk 1; Cleaning Tool SA No. 1 Mk 1; Pullthrough Mk 7. Also on the table is an ammunition tin containing 200 rounds of linked ball ammunition.

In the background, one soldier is practicing the challenging skill of firing the FN MAG from the hip, using the sling strap as a support. Note that the shoulder over which the sling went affected the tactical choices. If over the left shoulder (for a right-handed shooter), this offered more stability (the gun could be leveraged against the hip better), but it would slow down the movement of the gun from the hip to a bipod mount. With the strap over the right shoulder, it could be slipped off quickly into a bipod position, but had less stability for hip firing.



THE BIPOD AND THE LMG ROLE

The simplest of the MAG configurations is bipod mounted, in standard LMG format. There are essentially two physical positions for bipod firing: (1) with the gunner lying prone on the ground; (2) with the gunner propping the bipod legs on a forward support, such as a wall or the parapet of a trench. The keys to efficient and accurate shooting from the bipod are correct body alignment and weight distribution. In the prone position, the gunner needs to spread his feet out wide, dropping his heels as close to the floor as possible. The gunner needs to get his body weight squarely behind the MAG; the official US military advice to accomplish this is: “An imaginary line drawn through the weapon should bisect the firing shoulder and buttock, and continue through the heel of your foot” (US Army 2006: 4–6). The spread-legs position ensures that the shooter has maximum physical stability during fire, able to brace himself against the vibrations of the recoil.

Equally important during bipod shooting of the MAG is a firm, controlled grip on the stock, achieved by placing the non-firing hand on top of the stock, with the thumb curled below. The cheek beneath the shooting eye is then slid forward to make contact with the index finger on the stock; once this position becomes second nature, the shooter is able to adopt a consistent shooting position, aligning himself properly to the iron sights time after time.



A Royal Air Force Hawker Hunter flies above Royal Marines in the Radfan region during the Aden Emergency, Yemen, March 1967. The L7A1 GPMG provided the section with its principal form of support fire. Note how the gunner and his assistant split the burden of carrying the belted ammunition. (Photo by Terry Fincher/Daily Express/Hulton Archive/Getty Images)

The other classic bipod-mounted position involves the bipod legs sitting on a forward elevated platform. Here the gunner needs to think his position through. The MAG is controllable to fire, but the recoil is still hefty, especially in the standard MAG weapons with the hard buffer arrangement, as opposed to the softer-shooting M240. What the gunner needs to avoid is standing or kneeling straight upright, with the bipod legs flexing on the support and the gunner's body swaying under the impact. If the gunner is in a trench, then he should ideally have his chest resting against the front trench wall; alternatively, the gunner can lean against any upright support that gives the body some vertical rigidity. If the gunner cannot find such a support, then he should adopt a lunge position, with the left leg forward and bent deeply, in turn forcing the right shoulder into the gun. Note that in all the positions outlined above, left-handed firing is never recommended, because the ejection patterns described by the spent cartridge cases and the used belt links favor a right-handed shooter.



British soldiers prepare for operations in Kuwait, February 2003, during Operation *Telic*. The Middle Eastern theater has tested the L7A2's resistance to the region's fine, powdery sand, visible here covering the external parts. With regular and proper cleaning, and only light oiling, the gun stays reliable even in these conditions. (Photo by Giles Penfound/ Crown Copyright. IWM via Getty Images)

It should be mentioned that some of the international MAG manuals also describe techniques of shooting the MAG from a standing position during an assault maneuver, or even for AA fire. This feat ideally requires a gunner of broad and heavy physique, and bursts must be kept necessarily short as accuracy will always be poor. The British Army's manual for the L7A1 from 1966 describes this position as "Close Quarter Battle" (CQB) position. After

loosening the sling, the gunner should cock the weapon and engage the safety before lifting the gun; the sling is looped over the shoulder (left or right), the bipod legs are secured, and the ammunition belt is draped over the left arm. The manual points out that if the sling is looped over the left shoulder, it will take longer to deploy the weapon in the bipod configuration; the gunner should assess the situation when deciding which shoulder to use. During movement the weapon should be cocked, with the safety set to “fire” except when negotiating an obstacle, during which time the safety should be engaged.

The gunner should grasp the pistol grip with his right hand, keeping his forefinger clear of the trigger; the bipod is gripped with the left hand, avoiding contact with the barrel or gas cylinder. Upon seeing a target the gunner should lean forward with the left leg advanced toward the target, the gun pressed firmly into his right side. The gunner should employ his judgment and situational awareness, observing the target and correcting his aim accordingly. The manual recommends that although it is possible to fire while moving, it is better to halt briefly, fire, and then continue the advance (MOD 1966: 64–65).



A MAG-armed Australian Army soldier moves between cover in Afghanistan, 2010. His MAG is equipped with the 3.4×28 magnification C79 Optical Sight, known as the M145 in US use. (Spc Jonathan Thomas/US Army/Wikimedia/Public Domain)

Although the CQB position might sound a little outlandish with a gun the size and power of a MAG, it is not uncommon for such grips to be used in combat. Operation *Barras* was the daring British rescue of five British soldiers of The Royal Irish Regiment, conducted in Sierra Leone on September 10, 2000 by troops from 22 Special Air Service (SAS) Regiment and elements of 1st Battalion, The Parachute Regiment. During the action, SAS gunners armed with GPMGs were seen standing up and firing their weapons, doing so to gain visual clearance over the thick vegetation around the rescue site.

The MAG in its infantry LMG role is typically, although far from always, used with its conventional iron sights. The basic MAG sights consist of a forward blade, which corresponds with a folding leaf rear sight. To enhance the gun's accuracy over medium ranges, the front sight can be adjusted mechanically for both windage and elevation, and different post heights are available to alter the point of impact – there is a high blade (.46in) and a low blade (.39in). The rear sight features an aperture sight for shooting distances from 200m (219yd) to 800m (875yd), divided into 100m (109yd) increments, and this aperture can be flipped up to expose an open U-notch sight for taking the ranges out from 800m to 1,800m (1,969yd), again graduated every 100m via the ladder.

Sight technologies have, of course, moved on tremendously since the MAG was first launched more than a half-century ago. Today a sophisticated range of optics are available across the small-arms platforms, and the MAG has been just one beneficiary of these visual devices. Modern sight options for the MAG in LMG mode include the ELCAN-produced **C79 Optical Sight**, commonly used in Canadian Army service and in the militaries of Denmark, the Netherlands, and Norway. It has a 3.4×28 magnification, and is fitted with a tritium illuminated reticle to give good target acquisition in low-light conditions. The C79 is not a long-range sight, hence isn't ideally suited to sustained-fire roles and it appears on a variety of other infantry weapons, including standard-issue rifles and carbines. Mounted on a rail system, however, it can improve the accuracy of fire from a MAG up to 800m (875yd) range. It is also produced in a variant for M240 and M249 SAW use in the US armed forces, known as the **M145 Machine Gun Optic** and suited to engaging targets out to 1,200m (1,312yd). The US Army's field manual FM 3-22.68 describes the sight as:



November 2012: an Afghan National Army cadet takes cover on the edge of a hill as he prepares to offer cover with his M240 machine gun (fitted with a blank-firing adaptor) during a military exercise in Kabul. (Photo by Daniel Berehulak/Getty Images)

a telescopic sight. The telescope magnifies targets by three and a half times, so it appears to bring the shooter three and a half times closer to the target. The telescope shows the strike of the round more clearly and allows more accurate shooting. In low-light conditions, looking through the sight without the laser filter allows for more accurate target detection than not using the sight at all, that is, than relying on the naked eye. (US Army 2006: J-37)

The British forces have in recent years used another sight from the ELCAN stable, the **C2 Optical Dial Sight**, with similar capabilities to the C79. Yet it is interesting to note that the British troops in Afghanistan have also used the L7A2 in conjunction with the sight unit from the FGM-148 Javelin antitank missile system. In this configuration, the gun has consistently been delivering indirect fire out past 2,000m (2,187yd); indeed the average range of GPMG fire using the Javelin sight has been 2,700m (2,953yd), a range that strays into the territory of big beasts such as the M2HB.

There are issues with using combat optics on the MAG when it is in its LMG mode. Assault maneuvers are rough-and-tumble affairs, and while the iron sights on a MAG are fairly resistant to thumps, the same cannot be said for optical sights, which are easily knocked off-center. This is especially true in the case of machine guns like the MAG, which not only imparts heavy vibrations to a rail-mounted sight, especially when the gun is bipod mounted, but also shakes the sight every time the top cover is raised and slammed shut. Therefore, for lighter assault use, the iron sights can be the best option, and will give perfectly usable accuracy over 1,000m (1,094yd) range, given the compensating spread of full-auto fire. The optical sights are better when fitted to guns in a static support role, often delivering fire at targets beyond the range of standard infantry assault rifles.



The view through a 6×48 ACOG sight attached to an M240G during a US Marine Corps live-fire exercise in Djibouti, March 2015. (Lance Cpl Dani Zunun/USMC/Wikimedia/Public Domain)

TRIPODS AND THE MMG ROLE

Fixing the MAG to a tripod brings a whole new world of potential to the gun. Speaking generally, a properly emplaced tripod gives a machine gun two key properties: (1) greater stability on the ground and against its own recoil vibrations, giving improved accuracy; (2) the ability of the gun team to make fine adjustments to the accuracy and the “beaten zone” (the oval area of bullet impact), especially at long ranges. Both qualities work together to ensure that the tripod-mounted gun is able to utilize the full range capabilities of the cartridge it fires, including employing the gun in an “indirect-fire” mode, meaning that it can “lob” rounds against targets beyond visual range or behind cover, in much the same manner as an artillery piece. (When any weapon is fired straight at a target in a direct visual line between shooter and target, this is known as “direct fire.”)

The MAG has been mounted to all manner of tripods throughout its long service career, depending on the country and the period. Examples include the

British **Mounting, Tripod, Machine Gun, L4A1** to support the L7 machine guns and the **M122A1** tripod for the M240 weapons.



The MAG is manufactured under license in India by the Ordnance Factories Board; this example of the type is mounted on a tripod in a security post on the Indo-Pakistani border.
(Vikramaadityasumbria/Wikimedia/CC BY-SA 3.0)

A more detailed look at the M122A1 is useful to understand how the MAG is transformed by a tripod mount. The M122A1, according to FM 3-22.68,

consists of a tripod head, one front leg and two rear legs, and traversing bar. The traversing bar connects the two rear legs. It is hinged on one side, and has a sleeve and sleeve latch on the other that allows the tripod to collapse to a closed position for carrying or storage, or to lock in an open, extended position for use. The traversing bar also supports the T&E mechanism. The increments are numbered every 100 mils to 425 mils right of center. On the bar, there is a scale that measures direction in mils. It is graduated in 5-mil increments and numbered every 100 mils to 450 mils left of the center. (US Army 2006: 1-35)

The T&E (traverse and elevation) mechanism of the tripod is the critical part of the entire system. To traverse the weapon, the gunner or assistant turns a traversing handwheel, this moving the gun either left or right in 1-mil clicks, with a total of 100 mils traverse (50 to the left, 50 to the right). Similarly, the elevation handwheel lifts or lowers the muzzle by 1 mil for each click, with a total of 400 mils correction split equally between up and down.



A US Marine Corps machine-gun team work together to set up an M240 during a combined-arms exercise at the Marine Corps Air Ground Combat Center, Twentynine Palms, California, December 8, 2014. (Sgt Emmanuel Ramos/USMC/Wikimedia/Public Domain)

Another tripod option for the M240 in US service is the **M192 Lightweight Ground Mount**. For use with the M240B and the M249 SAW, the M192 is a lightweight tripod system (11.46lb) that has its own T&E mechanism. The M192 has been designed as a more portable tripod option, one that can be set up extremely quickly in front-line emergencies. It packs down so small that it can even be transported within a spare-barrel bag. The T&E mechanism comes with a 530-mil range of elevation and a 900-mil traverse, and it uses push and pull levers to allow the gunner to make fine adjustments. It also has a limit stop system to set the permitted limits of fire.

With the MAG tripod mounted, the gun can now engage targets out to 3,000m (3,281yd) and beyond. Of course, the tactical boundaries and the team requirements change fundamentally once a gun is tripod mounted. A bipod-mounted MAG can be handled by two men (gunner and assistant gunner), with one man to carry the gun and the other to transport extra ammunition, tools, and spare barrels. At a push, and particularly if the gun is fitted with a tactical ammunition box of just 50 rounds, the MAG is even open to being managed by just one person. Yet a tripod-mounted gun adds extra physical liabilities. The M122A1 tripod, plus the T&E mechanism, together weigh 19.84lb. A 50-round belt of 7.62mm ammunition weighs 2.71lb, so five such belts will total more than 13lb. Then we add the weight of the gun itself – 27.56lb – plus some gun tools and spare barrels, and in total the machine-gun crew will be handling around 66lb in weight. For this reason, tripod-mounted MAGs are usually tended by three-man teams, consisting of a gunner, gunner's assistant, and an ammunition carrier. (This model is based on a US infantry gun team, but the general principle is widely applicable.) Between them they must manhandle the components and deploy the weapon effectively in combat. In US platoon structure, the gun team will also be overseen by a team leader, typically an NCO,

who will be responsible for the weapon's tactical deployment. This role needs technically proficient and judicious handling if the MAG is to be used at its best. Considerations for the team leader include the timing of the fire in relation to other offensive or defensive maneuvers; the permitted angles of fire to ensure the safe forward passage of friendly troops; the total ammunition available and the likely ammunition expenditure; accurate information about the location of the enemy, and how to bring the fire to bear on the target; consideration of civilians in the area around the beaten zone, and how to limit civilian casualties.

Being able to extract the best from a tripod-mounted MAG also depends on the sighting arrangements used. While an optical sight is something of an option on a bipod-mounted gun, on a tripod-mounted weapon it is more of a necessity, at least if the gunner wants to maximize the full potential of the weapon. Once fitted with a modern rail system, the MAG can be enhanced by a wide range of sight options, including thermal-imaging and image-intensifying scopes for low-light or nighttime firing. British forces, for example, will utilize sights such as the **6× Maxikite**, which is particularly suited for long-range nighttime engagements, or the **VIPIR-2** thermal-imaging scope. For daytime work, the British opt for sights such as the C2. These sights and their many equivalents in other armed forces around the world, once allied to the intricate adjustments provided by the tripod T&E mechanisms, mean that the MAG can become a long-range killing device. At the full extent of its range, the only awareness an enemy will have of the opposing machine gun will be the rapid whistling of the bullets around them and the impacts on human bodies and materiel.

Combat Conditions and Handling the M240B

4-10. The trainer must realize that qualification is just a step toward reaching combat requirements. To reach this goal, the gunner considers his position, the use of his weapon, and some of the following combat conditions as well:

Most engagements are within 300 meters. However, the gunner must still engage targets out to the maximum range of the machine gun.

Enemy personnel are seldom visible except when assaulting.

The gunner directs most combat fire where he has detected the enemy or where he suspects the enemy of being, but where the gunner cannot see him. Area targets consist of objects or outlines of men irregularly spaced along covered and concealed areas (ground folds, hedges, borders of woods).

Most combat targets can be detected by smoke, flash, dust, noise, or movement, but the targets remain visible only for a moment.

Some combat targets can be engaged using reference points, predetermined fire, or range card data.

The nature of the target and irregularities of terrain and vegetation might require a gunner to move from one position to another to place effective fire on the target. The most stable position for the gunner is the prone tripod-supported position.

Most combat targets have low-contrast outlines and are obscure. Therefore, choosing an aiming point in elevation is difficult.

Time-stressed fire in combat includes fire at a single, fleeting target that must be engaged quickly; at distributed targets that must be engaged while they are available; and a surprise target that they must engage at once, with instinctive, accurate fire. (US Army 2006: 4-3-4-4)

M240 ambush

This plate shows a US Army recommended deployment (above) of two M240 machine guns from prepared field positions, the machine guns working together to ambush a linear target presentation, in this case a column of enemy troops and vehicles moving from left to right. The gunners open up the ambush with intense traversing fire, following a recommended fire pattern for a linear target with some depth: directing fire toward the center of the column initially, but swinging out to the flanks and back again. In this type of action, where the gunners have to establish a near-immediate fire superiority, they use their M240s in “rapid-fire” mode, specifically 200rd/min in bursts of 10–12 rounds, with a pause of 2–3 seconds between bursts. The barrel would need changing out after two minutes of such fire, but an ambush would likely be over within that time. Note that the gunners are also providing suppressive fire to enable infantry to move forward and attack around the flanks. For this reason, each firing position (below) has to be dug intelligently, the pair oriented so that they circumscribe an arc of fire that cannot stray out to the lines of approach of friendly troops. Note how the soldiers have built up banks of earth either side of the firing trench; these not only soak up return fire, but also act, in effect, like sector stakes, marking out each gunner’s arc of fire.



VEHICULAR MOUNTS

The term “vehicle mounts” covers an unusually broad spectrum of MAG configurations, far too many to chart in detail here. The most prolific type of vehicle mount – and by “vehicle” we can also include aircraft and watercraft – is the pintle mount. A pintle mount, at its most basic, is essentially little more than a metal post with a flexible bracket on the top for mounting a machine gun. The great virtues of pintle mounts are their cheapness and their versatility. Using such mounts, MAGs have been bolted to the full range of military vehicles, including armored personnel carriers, AFVs, light vehicles, trucks, helicopter doors, the side rails of naval vessels, fast-patrol boats and dinghies, and much more. Using such mounts, they can transform a defenseless or vulnerable vehicle into a platform boasting heavy mobile firepower.



The M1 Abrams was the first US main battle tank to be fitted with the FN MAG, as the M240. In this photograph from 1981, the smaller M240 (right) sits next to the larger .50-caliber Browning M2HB (left).
(US DoD/Wikimedia/Public Domain)

The current standard pintle mount issued by FN itself is the **Land Pintle Weapon System**. This takes either a spade grip MAG, known as the **MAG 58M**, or the standard MAG with fixed buttstock. Given that the nature of vehicular mounts often obviates the role of an assistant gunner, the weapon can also be

provided with a 250-round ammunition box and feed chute, to facilitate smooth belt feeding into the gun, plus a spent case and link catcher, to prevent the interior of the vehicle filling up with slippery brass and awkward bits of steel. The mount itself is not just a simple pole. As well as giving the user full traverse and near-vertical elevation, the mount also features a “soft mount” system that absorbs recoil. The mechanism can also incorporate fittings for day- or night-vision devices.



Here an M240B, manned by a Colombian marine, has been mounted to a riverine craft to provide on-deck security. The red blank-firing adaptor at the muzzle ensures that there is enough gas pressure to cycle the weapon when fired. (Mass Communication Specialist R.J. Stratchko/US Navy/Wikimedia/Public Domain)

An interesting model of pintle system is the American **M6** pedestal mount, fitted with the **M197** mount. This dual system is that typically used to affix the M240 to the Humvee vehicle. The primary mount is the M6, to which the gun is fixed for flexible fire control. The M197 arm projects out from the pedestal as a swing arm, and can be used to lock the gun in place, pointing in a safe direction, during transit.

Examples of pintle applications for the MAG are legion. Britain – to choose just one country – has been a prolific user of the vehicular MAG across all its armed services: Army, Royal Navy, and Royal Air Force. Within those services, the SAS have had a long love affair with the “Jimpy.” From the late 1960s the SAS Mobility Troop steadily adopted the GPMG for mounting aboard its Series IIA 90 Land Rover, and then (from 1985) the Land Rover 110 HCPU, known as the Desert Patrol Vehicle (DPV). It is fascinating to see how the GPMG was configured with other weapons to make the DPV one of the most formidable

pieces of mobile infantry firepower in the SAS Mobility Troop's arsenal, proving itself in conflicts from Operation *Desert Storm* in 1991 through to the recent deployments in Afghanistan and Iraq. A basic configuration was a single GPMG mounted at the front for the vehicle commander, and one or even two at the rear to provide an all-round defense. In addition to the commander's GPMG (this weapon tended to be a constant), other firepower aboard included .50-caliber Browning M2HBs, Mk 19 automatic grenade launchers, Miniguns, and even Milan wire-guided anti-tank missiles. The tradition of mounting the GPMG to SAS vehicles shows no signs of abating. The Supacat HMT 400 – known in British Army service as the Surveillance and Reconnaissance Vehicle/Offensive Action Vehicle – sometimes features two parallel GPMGs set in a twin mount just behind the forward seats. The Army's 4×4 Jackal or Mobility Weapon-Mounted Installation Kit boasts an M2HB as its main armament, centrally mounted, but with additional firepower bestowed by a forward-facing GPMG. Note that some forces also fit simple armor shields around the pintle mount, to provide a basic level of protection to the gunner from small-arms fire and from shell fragments.

FN also produces a three-type range of pintle mounts for helicopters. The Light Floor Pintle (LFP) mounts the gun to the floor of the helicopter; the Light External Pintle (LEP) has the mounting system on a frame outside the helicopter (and therefore does not interfere with the internal floor space); and the Light Window Pintle (LWP) is for clamping the gun to a window edge.



March 2015: at the Yuma Proving Ground, Arizona, M1151 Humvee-mounted M240s are prepared for a firing exercise. Each gun is mounted in a Common Remotely Operated Weapons Station II (CROWS II),

and the exercise is for familiarization training. (Staff Sgt Brian Barbour/US National Guard/Wikimedia/Public Domain)

Earlier in this book, we described some of the types of coaxial MAG machine guns, fitted to various armored vehicles. Yet vehicles have also received force multipliers in the form of MAG weapons fitted in advanced Remote Weapon Station (RWS) systems, which enable the gunner to engage targets remotely, usually from within the protective confines of an armored vehicle.

One of the latest stations from FN is a good example of the format and the technology currently on offer. The deFNder[®] Light is an RWS designed to take FN Minimi or MAG machine guns, the whole unit capable of being fitted to low-payload vehicles or to fixed positions such as building compounds or security checkpoints. Once a MAG is clamped into the deFNder[®] Light, its operator can deliver extremely precise fire through the system's sophisticated sighting options; in addition to the standard day sight, which according to FN "provides Narrow and Wide Field of Views for standard NATO detection, recognition and identification of targets at long ranges", there are also options for a night sight (LLCCD, IR thermal sight) and a laser rangefinder allied to a ballistics computer and even a target tracking system. A stabilization option is also available, meaning that the gun can still be fired accurately even when the vehicle is on the move across undulating terrain. Tracking onto target is extremely fast, with turn times of 90° per second. A +80° elevation angle and a -60° depression angle means that almost any target that presents itself can be engaged. The RWS also features an integral weapon management system, which includes an ammunition counter, an end-of-belt cut-off system, and a burst-length control facility. All this is contained in a metal box that provides the gun and the RWS with protection against small-arms fire and shell splinters.

There are multiple RWS systems on the market today, and they have had a transformative effect on guns such as the MAG. Not only do they enable the gunner to remain relatively comfortable under cover while operating the weapon, they also enable levels of precision fire rarely achieved on other mounts.



The M240 Common Remotely Operated Weapon Station–Lightning is one of a new breed of RWS. Of particular interest is the belt feed chute guiding the ammunition belt from the cartridge box to the gun. (US Army PEO Soldier/Wikimedia/Public Domain)

ANTIAIRCRAFT USAGE

Before moving on from mounts, it is worth considering one of the more demanding combat applications of the MAG – engaging aircraft. The challenge for a gunner engaging aircraft with the MAG is primarily that of applying the correct lead. There are essentially two options: (1) You maintain a fixed degree of lead between the nose of the aircraft and barrel of the gun, firing the gun on the move; (2) You fire at a fixed point in the sky, through which the aircraft has to fly.

The US Army's manual on the M240 clarifies some further techniques for judging and applying lead to aircraft:

H-4. If an aircraft is attacking his position, the Soldier sees the aircraft in a head-on or diving view. To engage this aircraft, the Soldier would fire slightly above the nose of the aircraft. Adjacent positions would see the aircraft in a crossing view. To engage the aircraft, these units would have to apply a proper lead. The method of applying lead depends on the technique used.

Football-Field Technique

H-5. When engaging high-performance aircraft (those flying in excess of 200 mph [293ft/sec]), gunners should apply a one-football-field lead in front of the target and fire at the rapid rate until the target passes through the tracer stream. If the target is a low-performance aircraft, such as a helicopter, with a speed of 200 mph or less, gunners should apply half a football-field lead in front of the target, firing the cyclic rate. With all Soldiers firing, a curtain of fire is formed because of slight differences in each Soldier's estimate of the distance and lead.

Reference-Point Technique

H-6. The unit leader designates terrain features as reference points. Upon spotting enemy aircraft, the leader commands, ENEMY AIR, REFERENCE POINT 1. At this time, the gunner points his weapon at reference point 1, elevates the weapon to about 45 degrees above the ground, and fires on command. Once he sights the target, he can make minor adjustments to align his fire on the target. (US Army 2006: H-1–H-2)

As this passage explains, tracer is an invaluable visual guidance for the engagement of enemy aircraft, bearing in mind the limitations such as tracer's different trajectory from ball rounds and its burn-out range. But tracer is also deeply unsettling to enemy pilots flying through it. In fact, machine-gun AA fire presents one of the lowest risks to a jet pilot burning fast through a combat zone – surface-to-air missile (SAM) systems, or computer-controlled AA cannon are the real threats. Yet as any combat-experienced pilot will tell you, high levels of AA tracer will give the appearance of a near impenetrable wall in the sky, especially at night when the tracer seems to both float and accelerate, creating disorientating optical patterns in the sky.

This effect was discovered in relation to the MAG during the Falklands War of 1982, most particularly during the landings at San Carlos Bay, and in the subsequent air attacks against British shipping there on May 21–25. With a maximum range of up to 4,000m (4,374yd), well within the low-level attack ceiling of the Argentine A-4 Skyhawk jets, the GPMGs around San Carlos Bay were able to throw up long streams of fire, highly visible because of the 1-in-2 tracer ratio. Although the GPMGs made a limited contribution to actual kills of Argentine aircraft, they did make the Argentine bombing runs far more problematic, and certainly helped in limiting further British casualties in what was to be a harrowing period for the British forces during the Falklands campaign.

From direct-fire missions against enemy troops to engaging low-flying jets, the MAG has consistently demonstrated its versatility alongside its traditional attributes of reliability and firepower. Through its repurposing, it has truly proven itself worthy of the label “general-purpose machine gun.” As we shall now see, however, its combat-proven capabilities have not meant it has been invulnerable in changing times.



A Royal Navy gunner aboard HMS *Dragon* (a Type 45 air-defense destroyer) fires at an aerial flare during a night-firing exercise. Tracer burnout is around 1,000m (1,094yd). (Photo: L(Phot) Dave Jenkins/MOD/Wikimedia)

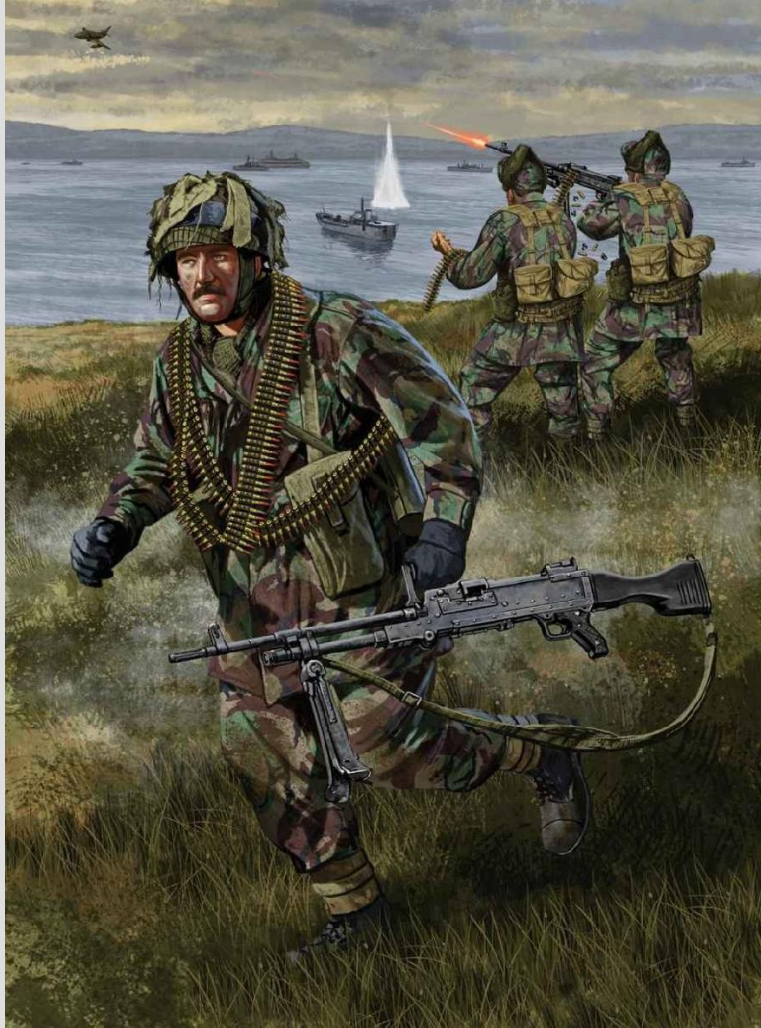
An Nasiriyah, Iraq, 2003

A US Marine Corps recon team gunner, from the 2nd Marine Expeditionary Brigade, fires an M240G from the top of a heavily armed Humvee during operations in An Nasiriyah, Iraq, in April 2003, while his comrade in the back of the vehicle provides fire from his M16A2, with under-barrel M203 grenade launcher. At the same time, further 7.62mm fire is delivered by a dismounted team, firing their M240 from its integral bipod, with empty belt links and ammunition cases stacking up beneath the gun. The swing-arm mount gives vehicular gunners a very wide range of traverse from otherwise restricted mounts such as the Humvee. In other instances, we see M240s mounted both at the front and the rear of Humvees using basic pedestal mounts, as an improvised measure to up-gun the vehicles during heavy street fighting. In our plate, the exposed position of the M240 gunner is evident, and casualties for this position were high. Thus during the battle, and throughout the Iraq invasion and subsequent counterinsurgency, soldiers began to add improvised armored shields in front of the guns, to give some measure of protection. Indeed, the Marine Corps itself would develop a curved vertical armor shield for use around the M240 and other weapon stations. The armor was light, but it would at least protect the gunner from most standard small-arms fire. Tactically, both M240 gunners here are providing suppressive/attrition fire against targets of opportunity. In urban combat, that typically means identifying muzzle flashes from doorways and windows, and immediately responding with heavy fire while lighter infantry move forward to gain assault positions on the building.



San Carlos Water, May 21, 1982

As an Argentine Skyhawk rips over San Carlos water, conducting a bomb run against British shipping in the bay, a two-man Royal Marine GPMG team open fire against the aircraft with their L7A2, set on a straight-post AA pintle mount. As the gunner traverses the weapon, maintaining a sustained lead in front of the nose of the jet, the assistant helps feed the snaking belt into the gun. Another Royal Marine in the foreground hurries to find an optimal position for his standard bipod-mounted GPMG. British manuals did show an antiaircraft firing position from the hip, but this was largely impractical in reality; bipod support was required, although it had limited traverse against jet targets crossing the line of sight. Although the likelihood of downing low-flying jet aircraft with a GPMG was slim, GPMG gunners contributed to several kills over San Carlos Water. In theory, the main tools of air defense around the bay were land-based and shipborne SAMs, such as the Rapier, Sea Wolf, and Sea Cat systems, but in many cases they struggled to acquire, lock-on to, and track the fast-moving targets as they passed in seconds across the bay and the rugged coastline. GPMGs, however, could respond almost instantly, alongside other machine guns (such as the .50-caliber Browning M2HB) and naval 20mm and 40mm cannon. Even if the bullets did not strike or down an aircraft, the strings of tracer still provided a visual distraction for the Argentine pilots, who might be disturbed from their bomb runs. Out in the bay, many ships had GPMGs pintle-mounted to guard rails, to deliver further intensification of the firepower.





IMPACT

Surviving changing times

A VIABLE CONCEPT?

In his *Soldier of Fortune* article, Peter G. Kokalis praises the FN MAG as the finest GPMG to see combat, but then – startlingly – asserts that the GPMG concept itself is not viable. We should note that Kokalis emphatically does *not* criticize the MAG's technology or firepower. Rather, and for reasons we shall delve into in more depth, he questions the very principle of the general-purpose machine gun, as *embodied* by the MAG.

Before we investigate this further, it is worth acknowledging Kokalis's strongly positive assessment of the FN MAG itself. I would certainly agree with his verdict, although we need to base this on more than gut feeling. Certainly the FN MAG has had a commercial success in its field that remains nearly unrivaled. As noted at the beginning of this book, the MAG has been sold to more than 80 countries worldwide, with more than 200,000 units manufactured to date. This has made it the bestselling GPMG among Western nations and NATO members, plus many other non-affiliated countries. There are certainly rivals in the GPMG field. One of the best, and a weapon to which the MAG is indirectly indebted, is the German MG3, a visually obvious descendant of the superlative MG 42. The MG3 has been adopted by more than 30 countries, who have appreciated the gun's venerable combat value. Its main distinctions from the MAG are its more slender profile plus its faster rates of fire – up to 1,300rd/min. In some senses, this rate of fire has undermined the MG3 over time, as the gun has endured into an age more cost-conscious when it comes to ammunition expenditure. Other prominent competitors to the MAG in the Western hemisphere are the M60 range, already mentioned, and the French AA-52. Although both have endured in service, overall they have lost the battle against the march of the MAG, which has partially replaced both guns in service with both US and French forces.

Lest we get too carried away with the success story that is the MAG, we should compare the gun to its equivalents from the former Soviet Bloc, specifically the PK/PKM family of weapons. The PK machine gun was

introduced in 1961, shortly after the MAG emerged. In many ways, it resembles the MAG in principle and format. It is chambered in the classic Soviet-era 7.62×54mmR rifle cartridge (this rimmed cartridge is one of the major distinctions between the PK and the MAG), and it is a gas-operated, rotating-bolt design with a quick-change barrel. The PK in turn spawned a whole series of variants, including the lighter PKM – one of the major weapons in the series – plus versions for fitting to vehicles and helicopters, and for taking night-sights and other optics. Because of Cold War politics and distribution conditions, the PK family of weapons spread throughout the Eastern Bloc and well beyond, particularly in Africa and East Asia. Rugged and reliable, and simply functional, the PKs have been manufactured in quantities far exceeding those of the MAG – possibly around one million weapons in total. For this reason, the PK and MAG have often ended up both fighting alongside each other on the same side, and have also confronted each other across the lines. Recent US combat reports from Afghanistan commonly refer to friendly forces coming under PK/PKM fire, and returning fire with the M240B. The following example is typical:



August 2017: a Venezuelan soldier carrying an FN MAG as the squad machine gun. Note the red-tipped tracers in his ammunition belt, with one tracer for every four standard ball rounds. (FEDERICO PARRA/AFP/Getty Images)

At 071500z MAY, TF Chosin reports effective SAF from PKM and AK at XD 744 624 on an Attack element. Unit returned SAF with M240B, M203, M4 and 60MM mortars. CAS requested, pushed to

TIC, and not able to support due to weather system of solid thunder storms up to 30,000 feet, RTB. No further contact with enemy, no injuries to personnel or equipment. TIC closed at 071744zMAY. (US Army 2007)

In such clashes, the PKM and the MAG are roughly evenly matched. The PKM's effective range is between 1,000m (1,094yd) and 1,500m (1,640yd), but it has, like the MAG, a maximum range of 4,000m (4,374yd). Rate of fire is slightly lower than that of the MAG, at 650rd/min.



A battle-worn PKM machine gun in the Ukraine, June 2015. The PKM is one of the most successful machine guns of recent history, and a battlefield rival to the MAG. (Mstyslav Chernov/Wikimedia/**CC BY-SA 4.0**)

The case of the PK shows us how much Cold War politics has played its part in the geographical distribution and commercial success of the MAG, just as they have in the case of the PK and its variants. Regarding the MAG, the breadth of its users have sometimes meant that opposing forces are both equipped with the weapon, in a duel of technological equals. A case in point was the Falklands War of 1982, where both Argentine and British ground forces were wielding the MAG. In the early-morning hours of May 28, for example, troops of 2nd Battalion, The Parachute Regiment, commanded by Lieutenant-Colonel Herbert “H” Jones, attacked Argentine positions at Goose Green. The two sides were similarly armed – the British with L1A1 rifles and Sterling machine guns, the Argentines likewise, and support fire was provided by FN MAG machine guns. Once battle was joined, it was the Argentine MAGs, intelligently positioned around the terrain to provide lethal arcs of fire, which gave the British troops one of their deadliest challenges. In return, the Paras unleashed streams of

fire from their own MAGs, firing more than 8,000 rounds in bursts of sustained fire that threatened to burn out their barrels. The depredations of the MAGs on both sides accounted for significant numbers of the casualties during that first major brutal land battle of the Falklands War.

The Falklands War is just one of the numerous conflicts in which the MAG has been tested and proven. Conflicts in which the MAG has featured include: the Indonesian Confrontation (1963–66); the Rhodesian Bush War (1964–81); the Six-Day War (1967), War of Attrition (1967–70), and Yom Kippur War (1973) in the Middle East; the Gulf War (1990–91); and heavily in the conflicts in Afghanistan (2001–present) and Iraq (2003–present). Its reputation in real-world combat has cemented its commercial success and widespread distribution, and despite its age the gun keeps securing commercial orders. In 2011, for example, France received 500 MAGs, the first of 10,000 such weapons ordered for the French Army.



A basic MAG tripod mount, as issued to Argentine forces; the traverse plate curves outward just in front of the trigger grip. (Joaquín Álvarez Riera/Wikimedia/Public Domain)

Its impact on the world scene has been increased by its genuine GPMG capability. In the infantry, the MAG tends to be applied as a platoon, company, and even battalion support weapon. In the US Army, for example, a platoon of light infantry will typically be able to draw on the support of at least two M240Bs, manned by members of the platoon weapons squad. Each gun will be crewed by two men: a gunner and an assistant gunner. The US Army's FM 3-

21.8 manual, *The Infantry Rifle Platoon and Squad*, breaks down the responsibilities of the two men in relation to the weapon. For the gunner, not only is he in charge of physically operating the gun in combat, he also has to understand the tactical contribution his weapon is making at both platoon and squad levels, and be able to provide fire-control advice to the leader of any attached rifle squad. The assistant gunner, meanwhile, has to monitor the mechanical serviceability of the gun, provide and supply ammunition when required, monitor ammunition consumption, spot rounds and make recommended corrections to the gunner, and also have the technical and tactical knowledge to step into the gunner's shoes if required.



A British soldier prepares to fire live ammunition from an L7A2 on the range at Okehampton Camp, Dartmoor, England, during an exercise in September 2017. The L7A2 here has been stripped of its stock and fitted with an optical sight for the sustained-fire role, the gun being mounted on an L4A2 tripod. (Photos by Matt Cardy/Getty Images)

In the British Army, looking at the structure of the infantry at the time of writing (and implicitly allowing for change in the future), the light infantry battalion can draw upon the support of six L7A2s contained within a Machine Gun Platoon, the guns operating in both light-support and sustained-fire roles.

But the standard infantry support duties have been just the tip of the iceberg of the MAG's impact upon the modern battlefield. Its GPMG roles have seen the MAG serve on land, sea, and in the air, mounted on trucks, tanks, jeeps, ships, and helicopters. The fact that the MAG is still utilized in such large numbers around the world would seem to attest that its position is secure. Yet for many of the last 40 years, the MAG has been defending its rationale against some new thinking about the small-arms composition of modern armies.



With an L7A2 at the ready, Royal Marines watch over a suspected pirate dhow during operations near Yemen, May 2009. (LA(PHOT) Dave Jenkins/MOD/Wikimedia)

THE LMG DEBATE

The period following the end of World War II was one of the most formative in firearms history. The chief development was not a matter of the operating system

- the firearms operating systems today are largely as they were in the late 1940s
- but mainly in terms of ammunition and firearms format.

Summarizing heavily, during the 1940s there emerged the first assault rifles; these were full-auto weapons that fired an “intermediate” cartridge of power somewhere between a pistol cartridge and a rifle cartridge. Such ammunition gave the user several advantages. First, the intermediate round gave excellent power, trajectory characteristics, and penetration over *practical* combat ranges – typically around 400m (437yd). Second, the lower recoil compared to a standard rifle round meant that *controllable* full-auto fire from the shoulder was possible, and for people of lighter body types. Third, a lighter, smaller round meant that weight for weight an individual soldier could carry a lot more ammunition than his battle-rifle-armed comrade. Finally, the more manageable recoil impulse meant that the time it took to train a new recruit to be a competent marksman was reduced.

The first intermediate-round production rifle was the German StG 44 of the war years, but shortly after the war there emerged the world-beating 7.62×39mm AK-47. Others quickly followed – the United States adopted the 5.56×45mm M16A1 in the 1960s; the British took the bullpup L85A1 in the 1980s (also in 5.56×45mm NATO); Germany produced the FN CAL, a 5.56mm version of the 7.62mm FAL rifle. Today, most of the world’s issue rifles are either 7.62×39mm, 5.56×45mm or (for the AK-74 family of weapons) 5.45×39mm.

The shift toward the intermediate rifle cartridge also pricked the interest of those involved in machine-gun design. During the 1950s and 1960s, a new concept was born – that of the Squad Automatic Weapon (SAW). The thinking was that the heavier, full-caliber machine guns were good for company- or battalion-level fire support, but were essentially too heavy and bulky for effective assault applications at squad or section levels. Assault rifles could partly compensate for the deficiency in fire at this level, but their light barrels meant that they were not well suited to putting down any sort of sustained fire, and their maximum effective range trickled off at around 600m (656yd). The SAW concept was intended to give the small front-line combat team mobile support fire in a physically manageable format. Thus from the early 1960s the SAW type emerged, essentially as a standard infantry assault rifle, but fitted with a bipod and a heavier and often longer barrel to soup up its fire characteristics, but still firing the intermediate cartridge. The Soviet RPD was the leading example, developed during the war years for the 7.62×39mm round, but it was replaced in the early 1960s by the RPK. The RPK was basically an AK-47

assault rifle, but with the fixed barrel extended out to 23.23in (as opposed to the AKM's 16.34in), fitted with a bipod, and with options for more substantial feed systems, such as a 75-round drum.

The SAW concept took hold in the Western world also. In Belgium, Fabrique Nationale produced what has been the most successful expression of the format in the FN Minimi, which went on to equip dozens of armies around the world. (The Weapon-series title *The FN Minimi Light Machine Gun* sits essentially as a companion piece to this volume, and is recommended reading for anyone wanting to understand more about the SAW concept and the development of postwar machine guns.) The Minimi, which entered development in 1974, was a radically different direction for the SAW and LMG concepts. Instead of producing a version of a standard rifle, FN developed an entirely new gas-operated gun. It fires the 5.56×45mm cartridge from either belts (including belts held in ammunition bags and containers) or infantry rifle STANAG magazines, with no mechanical modification. Instead of having a fixed, albeit heavier, barrel, the Minimi has a quick-change barrel, meaning that it is capable of delivering the rapid firepower more commonly associated with full-blown support machine guns. Its range, depending on the sight arrangements, extends out to nearly 1,000m (1,094yd), and its rate of fire can be as high as 1,150rd/min, although around 800rd/min is more common.

Some comparative statistics between the FN MAG and FN Minimi illustrate the physical and firepower differences between the two weapons.

	FN MAG	FN Minimi Mk 3
Caliber	7.62×51mm NATO	5.56×45mm NATO
Operating principle	Gas operated, open breech	Gas operated, open breech
Overall length	49.61in	min 37.40in/max 40.39in
Weapon width	4.67in	5.24in
Weight	26.01lb	17.64lb
Barrel type	Long	Long/short
Barrel length	24.80in	13.74in
Buttstock type	Fixed	Adjustable/telescopic/fixed
Cyclic rate of fire	650–1,000rd/min	800–1,150rd/min
Feed	Belt	Belt/magazine
Firing mode	Full auto	Full auto
Handguard type	n/a	Triple rail
Role	GPMG	SAW/LMG
Effective range	1,800m (1,969yd)	800m (875yd)

The standout differences between the two weapons here mainly center on dimensions and weight. The Minimi, while still no lightweight, is nevertheless significantly shorter and lighter than the MAG. It fires roughly the same number of rounds per minute as the MAG, and given that it can engage targets out to 800m (875yd), at first glance it would seem to steal the MAG's thunder in the under-1,000m (1,094yd) combat zone.

Certainly, the world has bought into the Minimi concept in a big way. The US armed forces eventually came to adopt the Minimi as the M249 SAW, which since the 1980s has been its central tool in squad and small-unit firepower. The British took it to heart as the L108A1 full-length barrel and shortened L110A1/A2 Para versions. More than 45 other countries now use the Minimi as a standard weapon, making the gun one of the most successful weapons of the post-1945 era.

So does this mean that the impact of the MAG, its very rationale, has been weakened by the SAW concept? Some critics have argued that the very concept of the GPMG is up for question. In the aforementioned article by Kokalis,

written in the mid-1980s as the Minimi was just entering consciousness, he raises a question over the MAG's positioning in the small-arms arsenal. He claims that the MAG and its ammunition constitute too heavy a load for a two-man team to be effective in the SAW role at the level of squad and platoon, while at the same time the weapon fails to provide sustained-fire support at the battalion level – not least because at the time of writing (1985), the weapon lacked a heavy barrel option. One historical counterpoint to Kokalis' conclusions is that since he wrote the article there have been some heavy-barrel versions of the MAG. The British forces, for example, have the L19A1 version with a heavier barrel, although the lighter version is far more common, largely for the reasons of excessive weight that Kokalis cites. Nevertheless, his point about the weight and burden of the MAG merits serious consideration.



The 5.56mm FN Minimi has become the standard LMG in many Western armed forces, often in place of the FN MAG. (FN Herstal/Wikimedia/[CC BY 2.5](#))

The MAG is certainly not a lightweight gun – it needs to have the weight it does to provide a stable platform for the firepower it delivers – and it is true that soldiers who carry the MAG for any period of time around the battlefield need to be of substantial build and endurance. Yet if, as Kokalis argues, the rationale for the GPMG is weak, I would expect to have seen both a decline in sales and an accompanying decline in battlefield application.

Regarding the former issue, I am unable to comment with any certainty, in the absence of any official sales figures. Common sense would seem to dictate, however, that the heavy investment in SAWs would likely have an impact on GPMG sales, if only on account of the limits of overall military budgets. Where we can make a more solid assessment is in the shifting priorities of military small-arms tactical thinking since the 1970s. A particularly useful case study relates to the British Army's adoption of the L86A1 Light Support Weapon

(LSW) during the 1980s, and how that subsequently affected investment in the MAG.

The L86A1 LSW was essentially the SAW concept applied to the L85A1 infantry rifle (also known as the SA80). The conversion included giving the rifle a longer and heavier barrel and a bipod, but otherwise there was little in the way of adjustments to the new role. The idea was that the LSW would serve as the main fire-support weapon for the four-man fire team. On paper, it had some qualities to recommend it for this role. It was light and maneuverable, and shared ammunition compatibility with the rifles carried by the other men in the fire team.

Military historian Simon Ball has commented on the tactical thinking behind the LSW in the post-Falklands War era, and also the effect of that thinking on the distribution of the GPMG within the infantry section (Ball 2006: 150). Ball contends that the British decision to limit the FN MAG to support roles and to issue the LSW at section level stemmed from an initial reluctance to adopt the four-man fire team in place of the larger section; it was believed that there were simply too few GPMGs to go around. Ball points out, though, that during the Falklands conflict the greater provision of GPMGs allowed British ground forces to embrace the fire-team concept. This positive evolution was disregarded, he argues, in the postwar development of doctrine, in which British forces – now armed with fully automatic SA80-series weapons rather than the FN FAL battle rifle – were to engage the enemy with all available firepower, rather than relying upon the GPMG to do the bulk of the work. The LSWs were essentially intended to assume some of the roles of the MAG as a GPMG, taking over its LMG and assault functions and pushing the larger machine gun over to platoon- and battalion-level sustained-fire support. This intention was executed despite the evidence of the value of the MAG in the Falklands War, in which the MAG was used highly successfully in the mobile assault role, despite its substantial weight and dimensions.

In the post-Falklands British Army, reality steadily unmasked the theory behind the LSW. First and foremost, the LSW actually shared many of the chronic reliability issues suffered by the rifle counterpart, including poor bolt locking, defective parts, problems with feeding and susceptibility to jamming from the ingress of relatively small amounts of dirt. Second, the LSW was actually very poorly suited to the support role for which it was intended. The lack of a quick-change barrel meant that the gunner had to maintain a very strict control over his rate of fire to avoid burning out the barrel – anything more than

80–100rd/min was asking for trouble. Note also that the LSW was purely magazine fed, from the standard rifle's 30-round magazines. So, if the gunner wanted to put down 100 rounds of fire in a minute, that process would still involve four magazine changes, each change resulting in several seconds of down-time for the gun.

The LSW was undeniably an accurate weapon, but that was also a problem in a fire-support context – it was too accurate to deliver convincing area suppression, especially when considering its low rate of automatic fire when compared to a full-blown machine gun. In fact, many LSW gunners soon found that the weapon was in fact better suited to precision sniper fire over 600m (656yd), relying on the gun's Sight Unit Small Arms, Trilux (SUSAT) sight and its semi-auto setting to hit individual human targets.

The lessons regarding the limitations of the LSW were steadily learned by the British Army during the 1990s and early 2000s. Progressively, the LSW was dropped from widespread use, and the SAW role was eventually taken by the British adoption of the FN Minimi weapon, which offered far greater volumes of fire by virtue of its belt feed and quick-change barrel configuration. Even so, the MAG has also persisted across the full spectrum of its GPMG role. In fact, recent combat experience in Afghanistan in particular has reinforced the value of the MAG in both the British and US armed forces, for two principal reasons. The first is the gun's total reliability, as described earlier in this book. The second is the issue of firepower, particularly over range.

Combat in Afghanistan raised a problem the Western armies had not been expecting – being outranged by their opponents. Up to the time of the Afghanistan conflict, the typical small-arms combat range was judged to be 300–400m (328–437yd), a range bracket across which 5.56mm weapons operate perfectly comfortably. Yet in the open spaces of Afghanistan, the Allied troops often found themselves faced with opponents armed with PKM LMGs and also Dragunov SVD rifles, both of which fire the powerful 7.62×54mmR cartridge. Thus the Allied soldiers were now being engaged at ranges well in excess of 600m (656yd), with their 5.56mm weapons struggling to respond effectively.



The L86A1 Light Support Weapon (LSW) was a generally unsuccessful attempt to boost small-unit firepower in the British Army; it was in no way comparable to the MAG. (© Royal Armouries PR.5455)

For this reason, the MAG experienced a further surge in its popularity. Reports from both British and American forces indicate that the L7A2 and M240B respectively were often added to the *section*-level firepower mix to ensure that the smaller units were able to respond to whatever challenges they faced from enemy weaponry. The fact that the heavy guns were being carried long distances on foot patrols suggests that the soldiers were far happier to endure the weight and logistical demands of the MAG than suffer a loss of fire superiority in the field.

Combat experience alone continues to cement the impact of the MAG in service, and at the time of writing it shows no signs of falling from the inventories of most of the armies that have adopted it over the years. By contrast, the recent material innovations in making the MAG lighter – in the form of the US M240L – are likely to keep the gun in service for many years, possibly decades, to come. In December 2011 the US Army even granted the M240L one of its greatest accolades. Employing titanium in its manufacture and 5lb lighter than the M240B, the M240L joined the ranks of 2010's Army Greatest Inventions (DDawson 2011). It is likely that the M240L's model of a lighter MAG, but with the same performance standards of old, will ensure that FN's most famous machine gun continues to hold sway over battlefields for the foreseeable future.



CONCLUSION

When researching any books on an individual firearm, I tend to find a very broad range of opinions, from those who firmly and unswervingly applaud a weapon to those who angrily denounce it. I expected to find the same spectrum of emotion when researching the FN MAG, but it has not been the case. There are certainly those who feel that the MAG can be a little too heavy, or that it is not always employed sensibly at a tactical level. Yet what everyone seems to be in agreement about is that it is a true “queen of the battlefield” (as one author described it), a weapon upon which a gunner and his surrounding comrades can utterly depend when their lives are on the line. Since the 1950s, hundreds of thousands of soldiers have gone into battle with the MAG either in their hands or acting as their support. Under the most extreme combat conditions, in every different type of theater, the MAG has not been found wanting. It will always be a hard act to follow.



Night-vision optics have transformed many weapons into round-the-clock performers, and the MAG is no exception. Here a US Marine Corps corporal mans an M240G at night during a mission in Helmand province, Afghanistan, 2014. (Sgt Joseph Scanlan/USMC/Wikimedia/Public Domain)

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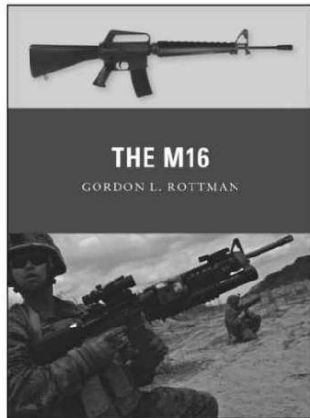
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ILLUSTRATORS

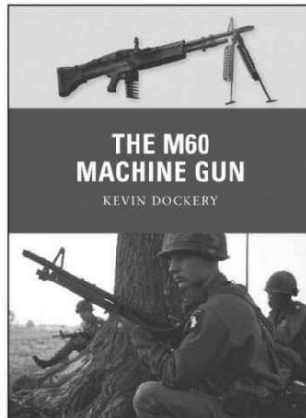
Johnny Shumate works as a freelance illustrator living in Nashville, Tennessee. He began his career in 1987 after graduating from Austin Peay State University. Most of his work is rendered in Adobe Photoshop using a Cintiq monitor. His greatest influences are Angus McBride, Don Troiani, and Édouard Detaille. Johnny completed the battlescenes for this book.

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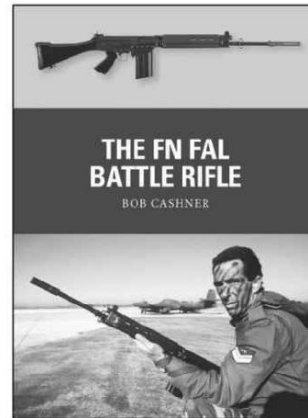
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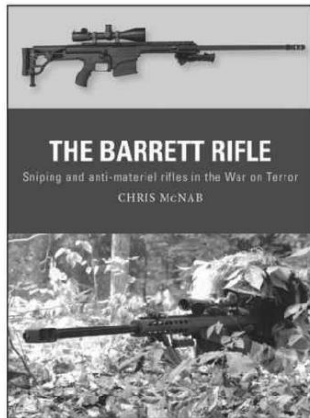
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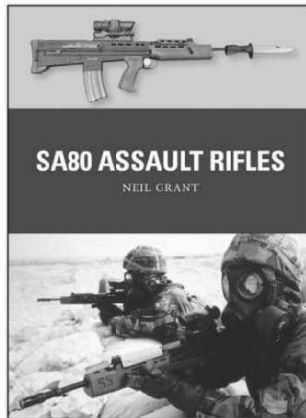
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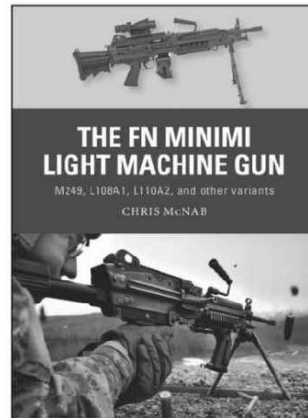
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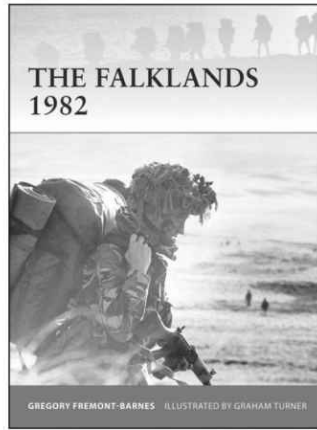


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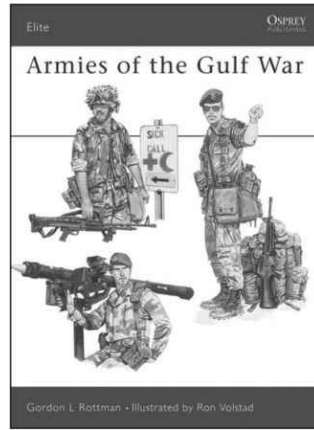


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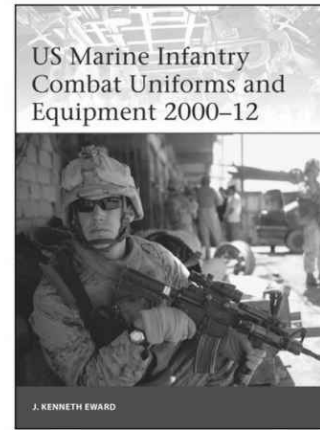
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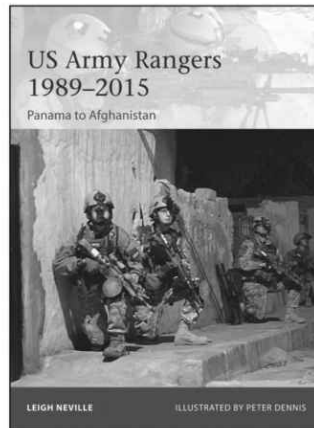
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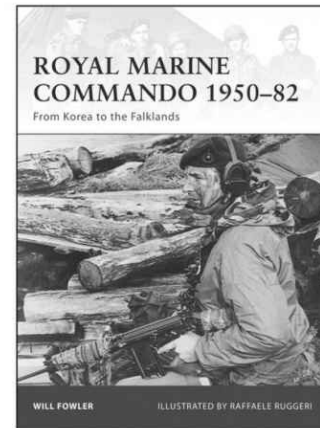
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Editor's note

In this book linear, weight, and volume measurements are given in US customary units of measurement (yards, feet, inches, pounds, grains). The exception is weapons caliber, where metric is used in many cases, depending on the context. The US military habitually uses metric for weapon ranges and distances. Conversions from metric into US customary are given in the text for clarity.

Front cover, above: An L7A1 GPMG. (© Royal Armouries PR.9475)

Front cover, below: US Army troops test-fire the long-barrel variant of the M240L machine gun at a range in Germany. Note that the collapsible stock is being made available for all infantry M240 types in US service. (Staff Sgt Pablo Piedra/US Army/Wikimedia/Public Domain)

Title-page image: An M240B in use with US Army paratroopers in Slovenia, January 2015. The FN MAG delivers an intense and highly visible muzzle flash, even in some daylight conditions. The flash is partly obscured here by the use of judicious front cover. (Program Executive Office Soldier/Wikimedia/CC BY 2.0)